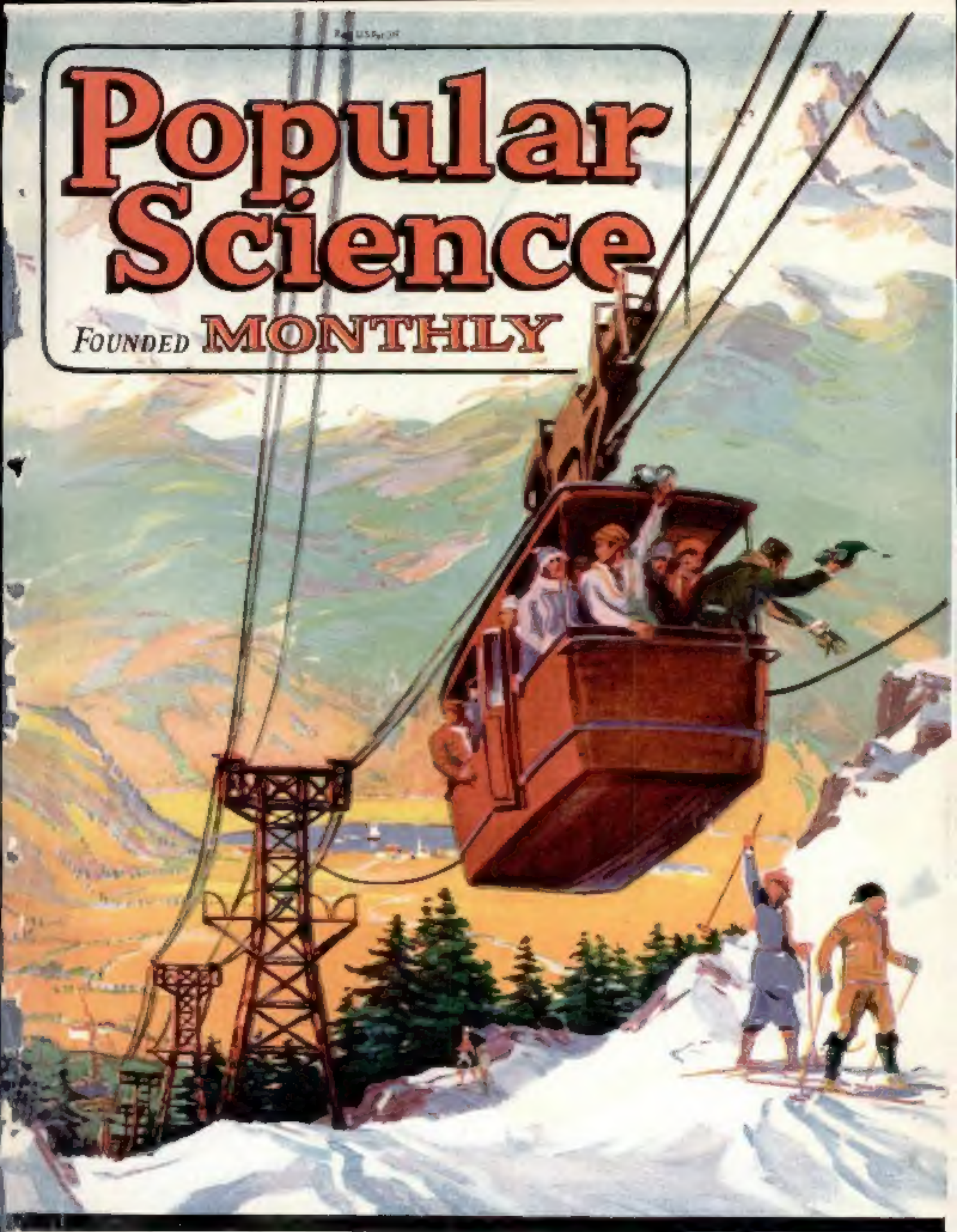


U.S. 4c

# Popular Science

FOUNDED MONTHLY



Summer to Winter in 40 Minutes (See page 40)

APRIL

Most Wonderfully Illustrated Magazine in the World

25 CENTS



# There's a Radiola

for every purse

## Low and Revolutionary Radio Achievements in the new Radiolas

**Radiola III**, an improved two tube receiver of antenna type, sensitive and selective. Complete with two WD-11 Radiotrons and headphones (everything except batteries and antenna) . . . \$35.

**Radiola III Amplifier**  
Two tube balanced amplifier for Radiola III, including two Radiotrons WD-11 . . . \$30.



(above)

**Radiola III-a**, which is Radiola III and its balanced amplifier complete in one cabinet including four WD-11 Radiotrons, headphones, and Radiola Loudspeaker (either type FH or UZ 1120). Everything except antenna and batteries . . . \$100



**Radiola Super-VIII**—an improved Super-Heterodyne. Selective and non-radiating. With no antenna, and no ground connection, it receives far distant stations, even while local ones are operating. Loudspeaker built in. Complete with six UV-199 Radiotrons—everything except batteries . . . \$425.

\$35

\$206

65

220

100

245

150

286

\$425

This symbol of quality



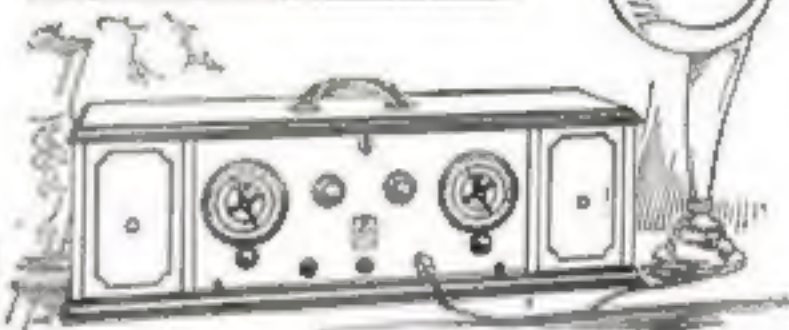
is your protection

It is impossible to give here full description of these revolutionary new sets. Send this coupon for an illustrated booklet that tells the story completely, with detailed description of every set.



(above)

**Radiola X**—ultra refined receiver of the antenna type, selective and non-radiating. Remarkable for distance reception and perfect reproduction. Built in new type loudspeaker. Complete with four WD-11 Radiotrons—everything except batteries and antenna. \$245.



(above)

**Radiola Super-Heterodyne (Second Harmonic)** same as Super VIII but semi-portable in mahogany finished cabinet, with separate Radiola Loudspeaker of either type, FH or UZ 1120. With six UV 199 Radiotrons, but without batteries, \$186. Same as above, but without Radiotrons or Loudspeaker . . . \$120.

(below)

**Radiola Regent**, a modified Radiola X, in mahogany cabinet, with external loudspeaker. With four WD-11 Radiotrons and Radiola Loudspeaker (FH or UZ 1120) but less batteries and antenna . . . \$206

Same as above, but without Radiotrons and Loudspeaker, batteries or antenna . . . \$150



Radio Corporation of America

Sales Offices

233 Broadway, New York 10 So. La Salle St., Chicago, Ill. 433 California St., San Francisco, Cal.

# Radiola

REG. U. S. PAT. OFF.

RADIO CORPORATION OF AMERICA

Dept. 114. (Address office nearest you.)

Please send me your new free Radio Booklet.

Name

Street Address

City

R. F. D.

State



# The SIGNAL FIRE of TODAY

**P**IONEERS of the old west were amazed to see how quickly the Indians learned of their presence.

The advance of a wagon train was known days ahead. Even a lone trader was known long before he arrived in the Indian camp.

Eventually the pioneers learned that the savages had a highly perfected signal code. From mountain top the signal fire blazed its message at night, or by day sent up its smoke in columns, wreaths, puffs—white smoke, black smoke—it carried a story far and wide.

Gone are the signal fires. Scattered are the tribes. Today the Westerner in remotest places receives his message by Radio—the Modern Signal Fire.

*The Crosley Radio Corporation owns and operates Broadcasting Station WFLW*

**CROSLEY**  
Better • Cost Less  
Radio Products



## A CROSLEY RECEIVER FOR EVERYONE

### CROSLEY TYPE V PRICE \$16.00

A one tube regenerative set, licensed under the Armstrong U. S. Patent No. 1,113,149. Actual performance of this little receiver have proven a revelation to the radio world. The McMillan expedition has consistently been clearly brought in with this instrument as well as Honolulu and other far distant points.

### CROSLEY TYPE 3-B PRICE \$42.00

This 3 tube regenerative receiver licensed under Armstrong U. S. Patent No. 1,113,149 combines the Crosley Type V and the Crosley two stage amplifier. In the hands of amateurs and professionals alike it has consistently outperformed sets costing a great deal more. A person hearing a broadcasting station may turn off the set by throwing switch and come back later without re-tuning.

### CROSLEY MODEL X-J PRICE \$35.00

A four tube radio frequency set combining one stage of Tuned Radio Frequency Amplification, a Detector and two stages of Audio Frequency Amplification. At bringing in distant stations we believe no instrument can equal it. Local interference is easily and quickly tuned out. We unhesitatingly claim that the Crosley Model X-J is the best receiver ever offered to the public.

### CROSLEY MODEL X-L Console PRICE \$120.00

A duplicate of the Model X-J except for the arrangement and mounting into a beautiful mahogany cabinet with the addition of a built in loud speaker. Space is provided in the cabinet for housing the necessary batteries. A special mahogany stand as illustrated in outline for the Model X-L may be had for \$25 extra.

This instrument provides an exquisite piece of furniture for any home together with all the pleasures of a long distance radio receiver.

### Crosley Instruments Are Sold By Best Dealers Everywhere

Write for Complete Catalog which fully describes the Crosley line of regenerative and radio frequency receivers and parts.

## THE CROSLEY RADIO CORPORATION

POWEL CROSLEY JR., President

Formerly

The Precision Equipment Company and Crosley Manufacturing Company

417 ALFRED STREET

CINCINNATI, OHIO

The Largest Manufacturers of Radio Receivers in the World

—MAIL THIS COUPON TODAY—

The Crosley Radio Corporation,  
417 Alfred St., Cincinnati, O.

Gentlemen—Please mail me free of charge your complete catalog of Crosley instruments and parts.

Name.....

Address.....



# Popular Science Monthly

Most Wonderfully Illustrated Magazine in the World

APRIL, 1924; Vol. 104, No. 4  
25 cents a Copy; \$2.50 a Year



Published in New York City at  
225 West Thirty-ninth Street

**M**ANY people ask why POPULAR SCIENCE MONTHLY has such power to attract and hold the interest. Perhaps the answer is that service is its underlying policy. In every field of human activity, every day in the year, science, in some way, serves us. Through science this magazine seeks to help men meet their needs; to get more out of life—mentally and materially—by keeping apace with discovery and invention.

**F**ROM a reader in Fort Worth, Texas, comes this letter: "I notice that Doctor Abderhalden, a German specialist, promises future men life running into hundreds of years. That's all very well, but I am more interested in knowing if there is any way that I, an average healthy man, can prolong my life. Have I any reason to believe that I have more chances for a long life than my grandfather?"

Not an unusual letter, that, but one typical of the hundreds of letters which each month contribute to the building of POPULAR SCIENCE MONTHLY. It is based on a natural, wholesome, and general curiosity.

Life, beginning and ending in the mysterious unknown, is short at the best and most of us are interested in prolonging it. Except man, most animals live to a minimum age of 10 times the age at which they reproduce. So, in response to our reader in Fort Worth, an unusual service article, "How to Add Twenty Years to Your Life," by James A. Tobey, executive secretary of the National Health Council, has been prepared for our May issue.

**R**ECENTLY on a trip through the East and the Middle West, I met several hundred persons who read POPULAR SCIENCE MONTHLY regularly. They expressed themselves frankly about the magazine and offered numbers of con-

structive suggestions. The things these readers told me have been of immense value in selecting material of widespread popular appeal for forthcoming issues.

**S**INCE opportunities of talking face to face with readers are infrequent, however, we must rely on letters such as that from the gentleman in Fort Worth. A suggestion from a reader in New Jersey is responsible

for Phil Riley's remarkably interesting series, "Adventures in Home Ownership," which begins in this issue. Mr. F. A. Platte, our automotive engineer, is writing for the May issue a valuable story on automobile steering mechanism, in response to an inquiry from Des Moines. Without these letters we might fall short of our service possibilities. We cannot get too many of them.

**W**E URGE our readers to write to us, for we seek, in our field, to reach out and answer those questions that keep coming up in the minds of most men. It is our business to interest you and hold your interest. We don't want to force upon you a lot of information you don't want and cannot make use of. But that we may fit the truths of science to your particular needs, your co-operation, your helpfulness, and your friendly sympathy are necessary. Letters from readers are our best

guide in judging the trend of current thought.

**W**E WANT your criticisms. We want your comments. We want your suggestions. And we

want to try to answer any question that keeps rising in your mind. Editing POPULAR SCIENCE MONTHLY is like rolling a huge snowball—the more pushers the faster the ball rolls. And the bigger the ball grows the more pushers it needs.—  
**THE EDITOR.**

## In Next Month's Issue

**How Long Are Your Legs?**—Every inch is a measure of brain power, says Henry E. Garrett, Ph.D., of the Department of Psychology, Columbia University. He tells how to gage your intelligence by your stature.

**Does Your Watch Know You?** Samuel Bernard, expert watchmaker, explains surprising facts about the most temperamental of all our mechanical servants.

**"The Steering-Wheel Broke"**—How often have you read that with a shudder? F. A. Platte describes simple safeguards against steering-gear catastrophes.

**Selecting Radio Parts**—Jack Binns gives valuable tips on how to choose units that will give best results.

*And 200 other fascinating articles and pictures*

## POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, \$2.50; foreign countries, \$3. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1924, by the Modern Publishing Co. The contents of this magazine must not be reprinted without permission. H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer





# I Tell You

## This Free Book Will Show You The Way to Amazing Salary Increases

*I only ask that you risk two cents on the strength of my word that the contents of this amazing book will show you the way to a prosperity that you never dreamed possible, in a fascinating field that you never thought of entering. This book is now free. Read my offer.*

By J. E. GREENSLADE

### Read What They Say

#### \$9,000 First Year

Ellie Summer Cook, 20 E. Jackson Blvd., Chicago, left a \$25 a week job and last year made \$9,000!

#### \$100 a month to \$100 a week in only 3 months

H. D. Miller, another Chicago boy, was making \$100 a month as a stenographer in July, 1922. In September, 3 months later, he was making \$100 a week as a salesman.

#### \$150 to \$500 a month

W. P. Clenny of Kansas City, Mo., stepped from a \$150 a month clerkship into a selling job at \$500 a month. He is making \$850 a month now.

#### \$6,500 a Year

M. V. Stephens of Albany, Ky., was making \$25 a week. He took up this training and now makes 5 times that much.

#### Small Pay to Big Earnings

J. H. Cash of Atlanta, Ga., exchanged his \$25 a month job for one which pays him \$500 a month.

#### Now Sales Manager at \$10,000 a Year

O. H. Malfroot of Boston, Mass., stepped into a \$10,000 position as a SALES MANAGER—so thorough is this training. All these successes are due to this easy, fascinating and rapid way to master certain invincible secrets of selling.

### EMPLOYERS

are invited to write to the Employment Dept. of the N. S. T. A. We can put you in touch with just the men you need. No charge for this service to you or our members. Employers are also cordially invited to request details about the N. S. T. A. Group Plan of instruction for entire sales forces. Synopsis and charts sent without obligation.

**F**IRST let me ask you two questions. One: Do you consider that you are as intelligent as the average mail-clerk, farmhand, office clerk, mechanic, or bookkeeper. I ask you this because most of the men whose salaries have jumped are just ordinary, every-day sort of men.

Second: If you suddenly found yourself with all the money you needed to spend, wearing the best clothes, living in the finest neighborhood, driving a good car and belonging to the best clubs—but having to make good in a job that paid \$10,000 a year, would it scare you? There are men to whom \$10,000 a year is so much that the idea of earning it themselves never occurs to them. They will always be in routine jobs at low pay. Their dreams will never come true. But yours will if you will absorb what I am going to tell you. For my work in life is to take ordinary men from blindalley jobs and show them how they can quickly make more money than they ever dreamed possible. And if you will give me a chance I'm going to show you how it's done!

Now, in one quick step you can enter the field where opportunities in your favor are ten to one—the Selling field. You know that Salesmen top the list of money-makers—that the salesman is his own boss—that his work is fascinating, interesting and highly profitable? But the thing you doubt is your own ability. All right, but you can become a first-class, money-making salesman in an amazingly easy way.

### Proof That Salesmen Are Made—Not "Born"

You might laugh if I told you that in a few weeks or months you could be making good in a big way in the Selling field. Thousands before you have laughed—perhaps bitterly—at the idea, but many of these thousands are now making big money as salesmen.

The story of six men who once thought salesmen were "born," who did not believe they were "cut out for selling," is on this page.

Thousands of men like these six—men who formerly thought salesmen were "born," are now enjoying magnificent earnings in the selling field. They were bookkeepers, mechanics, farmers, clerks—even doctors, lawyers and ministers—but in a few months after writing to the National Salesmen's Training Association they were out in the field selling—and making more money than they had ever hoped to make in their former vocations.

Sounds remarkable, doesn't it? Yet there is nothing remarkable about it. Salesmanship is governed by rules and laws. There is a certain way of

saying and doing things, a certain way of approaching a prospect to get his undivided attention, certain ways to overcome objections, batter down prejudice, overcome competition and make the prospect act.

Just as you learned the alphabet, so you can learn salesmanship. And through the NATIONAL DEMONSTRATION METHOD—an exclusive feature of the N. S. T. A. System of Salesmanship Training—you gain actual experience while studying.

The NATIONAL DEMONSTRATION METHOD gives you experience and knowledge that enable you to overcome sales obstacles of all descriptions easily. It is one of the many reasons why N. S. T. A. members make good as salesmen right from the start.

### A Lifetime of Selling Experience in a Few Weeks—Then Success

No matter what you are doing now, I can prove to you that you can gain years of selling experience in a few weeks—that you can go out and successfully sell goods—that you can make more money than you ever dreamed possible.

The N. S. T. A. System of Salesmanship Training and Employment Service will enable you to quickly step into the ranks of successful salesmen—will give you a big advantage over those who lack this training. It will enable you to jump from small pay to a real man's income.

### Remarkable Book, "Modern Salesmanship" Sent FREE

With my compliments I want to send you a most remarkable book, "Modern Salesmanship."

It will show you how you can easily become a master salesman—a big money-maker—how the N. S. T. A. system of Salesmanship training will give you years of selling experience in a few weeks; how our FREE employment service will help select and secure a good selling position when you are qualified and ready. And it will give you success stories of former routine workers who are now earning amazing salaries as salesmen. Mail the coupon to-day. It may be the turning point in your life.

### NATIONAL SALESMEN'S TRAINING ASSOCIATION

Dept. 15-D

Chicago

Ill.

National Salesmen's Training Association, Dept. 15-D, Chicago, Ill.

I simply want to see the facts. Send me the free your book "Modern Salesmanship," and Proof that I can become a Master Salesman. Also tell me how you can help me to a position.

Name.....

Address.....

City..... State.....

Age..... Occupation.....



NATIONAL SALESMEN'S TRAINING ASSOCIATION



# HEALTH

## Results from the Adaptation of the "Power Within" to the Stress of Environment

**I**T IS a question of relativity.

Disease is the result of supernormal stress or of subnormal resistance.

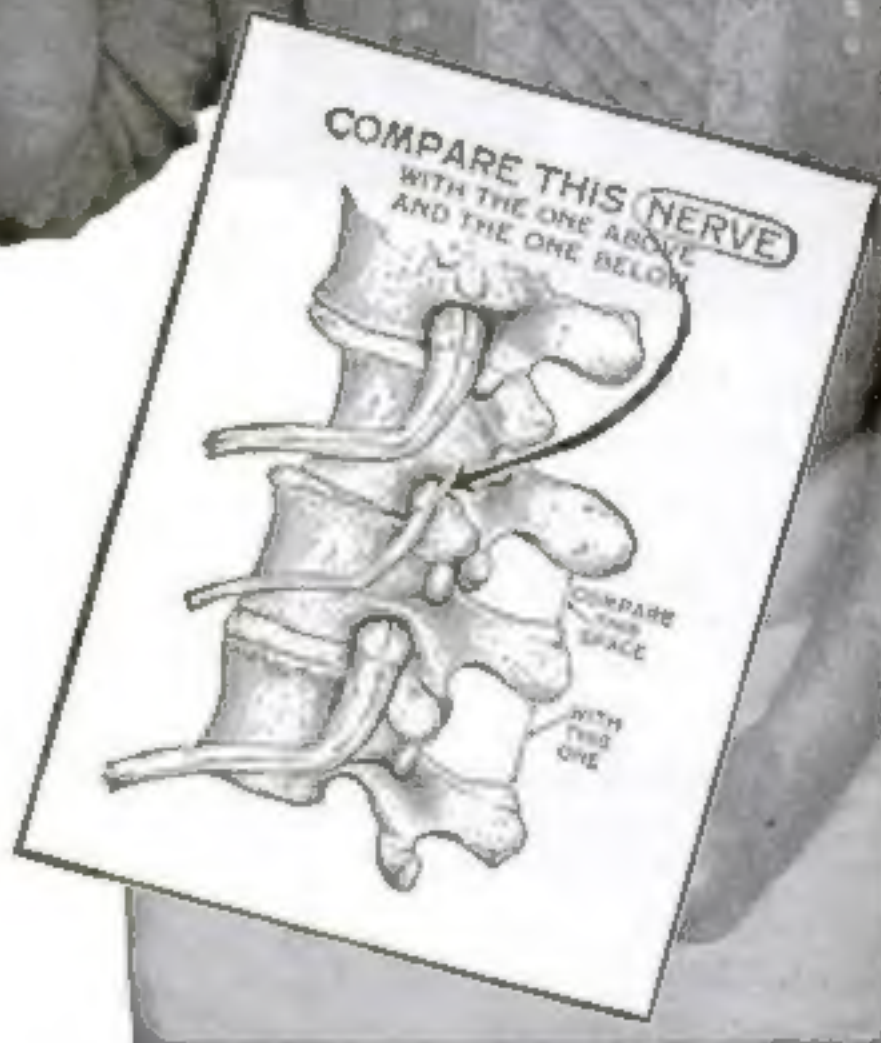
When the nerve, over which the "power within" sends its adaptative impulses to the cells, is impinged by a subluxated vertebra, the "power within" cannot adapt the organism to the stress of environment and we become sick.

To regain health it is necessary to turn on the power of adaptation—resistance.

To turn on the power, the impingement must be removed from the nerve, in order that it may again function normally.

To remove the impingement the misaligned vertebra must be adjusted, and this adjustment of the vertebra is the work of the chiropractor.

By giving Chiropractic a fair trial millions have recovered their health.



Write for information regarding Chiropractors or Schools to the

**UNIVERSAL  
CHIROPRACTORS'  
ASSOCIATION**

Davenport, Iowa,  
U.S.A.



### DEFINITION

The practice of Chiropractic consists of the palpation and adjustment, with the hands, of the movable segments of the spinal column to normal position for the purpose of relieving the primary impingement.



# What's Back of the Man Who Wins?



Did you ever observe what an easy time the man at the top seems to have—compared with the chap underneath?

—Makes more money, too—ever so much more money—yet he practically comes and goes when he pleases, turns all the hard work over to his assistants, and, in fact, "lives just like a lord, while we poor slaves—look at us!"

Sounds familiar, doesn't it—that plaint of the man in the routine job, whose utmost vision is bounded by "fifty a week" and who has deceived himself into thinking that the only way he can ever beat the game is to "work up a pull with the boss"—

Such a man forgets that the one best pull—and the only pull that is worth a continental—is ability to deliver.

And he fails to realize, too, that ability to handle important matters—decide perplexing problems—dictate far-reaching policies—comes only with a sound and thorough understanding of **BUSINESS PRINCIPLES AND METHODS**—an understanding which invariably must be based upon **EXPERIENCE**.

There are many ways to **GAIN** experience—but the shortest and surest route is thru **SPECIALIZED TRAINING**.

## The Confidence That Comes With Knowledge

Because LaSalle Extension University has been privileged to be of aid to thousands of men whose progress had been checked by the fact that they did not **KNOW** what to do in the more important positions they aspired to—and **KNEW** that they did not know—it is only right that other men, faced with similar problems, should have an opportunity to find out how these men have overcome that fatal obstacle.

We have therefore assembled from the thousands of letters in our files a composite message to the man who doubts his power for success.

While in practically every case the LaSalle-trained man who writes of his experience has made a gratifying gain in earning power, it will be noted that the thing which has brought him greatest satisfaction is his newly acquired **CONFIDENCE**—sure stepping-stone, when based on true ability, to the highest and most responsible positions.

The first letter is from a man who had "studied forty-two years" and had finally become a chief chemist, making \$4,000 a

year. When he came to LaSalle he called himself a "business failure." Less than a year later he wrote as follows (the italics in this and subsequent quotations are ours):

"Take away all I have learned for close to 42 years, but leave me my five months' study, and I should not be a loser by any means. Before, I was merely a good chemist, but now I am a man, and am standing squarely on my feet. Accountancy is only a first step, but it is a splendid foundation. It should be supplemented with your course in Business Management. I have taken only three lessons of this last course, but it has opened my eyes. Now I am after a \$12,000 a year job. It is immaterial whether I get it or not. The point is that in my inner self I am convinced that I am worth it, and that I can deliver the goods."

R. H. BOTS, New Jersey.

The following quotations tell their own story:

"It took your course of instruction to give me the courage and self-confidence to tackle the greater task and to enable me to make my dreams come true." (The writer, Mr. Orahood, increased his salary 191 per cent in less than three years.)

C. A. ORAHOOD, Ohio.

"Nineteen months ago I was a stenographer with a stenographer's salary and a vague idea that I wanted to know more about my work. Today—thanks to your course in Modern Business Correspondence—I have a department of my own in which I handle the work I used to take in dictation, with a 75 per cent increase in salary. The whole field of business has been opened to

me, and my aims have gone higher and higher. Lately I have had an offer from the sales manager to represent the company on the road. It's the biggest thing that has come my way, and it's the result of LaSalle training."

L. A. M. LEWIS, Ohio.

"Since taking up your training in Law, my salary has increased 123 per cent. The gain came, but it hasn't ended, for where I previously had to sidestep to let a man step ahead of me into a better position, I am now stepping ahead of the other man."

GERBARD A. SCHLEETER, Illinois.

"My course has benefited me many thousand-fold, for it has not only doubled my salary but has given me the confidence and technical knowledge necessary to assume direction in the banking world."

ERIK HANSEN, Wisconsin.

"I have increased my earnings more than three hundred per cent. Strange as it may appear, however, the financial benefits have not made much impression on me. The fascination of the work—the solving of intricate problems—the feeling of dominion, the knowledge that every problem can be solved if we diligently apply ourselves, is worth much more than the financial increase."

C. W. SHELDON, Wyoming.

"When I enrolled, I was a clerk in the cost department of a large foundry. Today, I am office manager, with an increase of about 300 per cent in salary. This course certainly was the starting point; for once a man gets the confidence in his ability that your training gives him, he can take a real job and handle it. Salary increases follow naturally."

W. F. STUNKKE, Wisconsin.

"From a salesman in the ranks, in two short months my sales have shot up nearly 150 per cent, and I have received a promotion from a company I had been with only six months. I am now a district manager, with eleven men working under me. Not only have my immediate sales shown an increase—and right in the middle of the summer months—but I have had a keener grasp of the principles of selling. I know the meaning of 'fundamentals' now; I know that by the application of certain definite truths, certain definite results can be attained. My effort, formerly more or less of an uncertainty, is now a certainty. Getting down to brass tacks, I know what I am doing now."

C. RUTHERFORD, Ontario, Canada.

## Make Your Start TODAY!

In preceding paragraphs successful men—men with no better start than you—have told of the working tools that gave them confidence.

These letters could be paralleled by thousands of similar letters—all taken from the files of LaSalle and quoted verbatim—yet there would still be men who would say, "That's all right for them, but it wouldn't help me"—or—"Some day, but not Now."

LaSalle cannot supply initiative—the determination to get on. Men who lack these qualities will not gain by reading further.

Others—men in whom the seeds of success are deeply planted—will profit greatly by the literature LaSalle will gladly send them—and they will send for it today.

The coupon will bring it to you without obligation.

# LASALLE EXTENSION UNIVERSITY

The Largest Business Training Institution in the World

LASALLE EXTENSION UNIVERSITY

Dept. 483-R

CHICAGO, ILLINOIS

Please send me catalog and full information regarding the course and service I have marked with an X below.

Also a copy of your book, "Ten Years' Promotion in One," all without obligation to me.

- |  |   |   |  |
|--|---|---|--|
| <input type="checkbox"/> <b>Business Management:</b> Training for Official, Managerial, Sales and Executive positions.   | <input type="checkbox"/> <b>Traffic Management—Foreign and Domestic:</b> Training for positions as Railroad or Industrial Traffic Manager, etc.   | <input type="checkbox"/> <b>Industrial Management Efficiency:</b> For Executives, Managers, Office and Shop Employees and those desiring practical training in industrial management principles and practice.                       | <input type="checkbox"/> <b>Expert Bookkeeping:</b> Training for position as Head Bookkeeper.  |
| <input type="checkbox"/> <b>Modern Salesmanship:</b> Training for Sales and Advertising Executives, Solicitors, Sales Promotion Managers, Salesmen, Manufacturers' Agents and all those engaged in retail, wholesale or specialty selling. | <input type="checkbox"/> <b>Railway Station Management:</b> Training for Station Attendants, Cashiers and Agents, Division Agents, Traveling Auditors, Transportation Inspectors, Traveling Freight Agents, etc.          | <input type="checkbox"/> <b>Personnel and Employment Management:</b> Training for Employers, Employment Managers, Attendants, Industrial Engineers.   | <input type="checkbox"/> <b>Business English:</b> Training for Business Correspondents and Copy Writers.   |
| <input type="checkbox"/> <b>Higher Accountancy:</b> Training for positions as Auditor, Comptroller, Certified Public Accountant, Cost Accountant, etc.   | <input type="checkbox"/> <b>Banking and Finance:</b> Training for executive positions in Banks and Financial Institutions.  | <input type="checkbox"/> <b>Modern Business Correspondence and Practice:</b> Training for Sales and Collection Correspondents; Sales Promotion Managers; Credits and Office Managers; Correspondence Supervisors, Secretaries, etc. | <input type="checkbox"/> <b>Commercial Spanish:</b> Training for positions as Foreign Correspondent with Spanish-speaking countries.   |
| <input type="checkbox"/> <b>Law:</b> Training for Bar; LL. B. Degree.  | <input type="checkbox"/> <b>Modern Foremanship and Production Methods:</b> Training in the direction and handling of industrial forces—for Executives, Managers, Superintendents, Contractors, Foremen, Sub-foremen, etc. |   | <input type="checkbox"/> <b>Effective Speaking:</b> Training in the art of forceful, effective speech for Ministers, Salesmen, Fraternal Leaders, Politicians, Clubmen, etc. |
| <input type="checkbox"/> <b>Commercial Law:</b> Reading, Reference and Consultation Service for Business Men.  |   |   | <input type="checkbox"/> <b>C. P. A. Coaching for Advanced Accountants.</b>  |

Name \_\_\_\_\_ Present Position \_\_\_\_\_ Address \_\_\_\_\_





Public Buildings Are  
Big Users of Electricity



Electrical Construction  
Needs Trained Experts



Electricity Railways  
Offer a Big Field

# ELECTRICITY

## Electrical Experts Earn

### The Men in the Picture

Below is a picture of L. L. Cooke, Chief Engineer, and his Engineering Staff, engaged in Students' Consultation Work. Through this Free and unlimited consultation service, nine trained and competent engineers help the students of this school with the problems that come up in their work—not only while they are studying but for years afterward—just as long as they care to use it. Think what this means to you—having a group of engineers advising and helping you—without costing you one penny.

This is only one of the features of the unbeatable "Cooke" Service that backs up "Cooke" Training.

## Be a COOKE Trained Electrical Expert

Now you earn \$20 or \$30 or \$40 a week. In the same six days as an Electrical Expert you can make \$70 to \$200 and make it easier—not work half so hard. Why, then, remain in the small-pay game, in a line of work that offers no chance, no big promotion, no big income? Fit yourself for a "bossing" job—Be a Cooke Trained Electrical Expert.

Today even ordinary Electricians—the "screw driver" kind—are making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the "Electrical Expert,"—who is picked to "boss" the ordinary Electricians—to boss the Big Jobs—the jobs that pay \$3500 to \$10,000 a year.



## The "COOKE" Trained Man





Hydro-Electric Plants  
Being Built Everywhere



Large Power Plants Need  
Experts to Operate Them



Automotive Electrical  
Men Are Needed

# for BIG PAY

## \$3500 to \$10,000 a Year

Get in line for one of these "Big-Pay Jobs" by enrolling now for my easily learned, quickly-granted, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

### Age or Lack of Experience No Draw-Back

You don't have to be a High School graduate—it isn't even necessary that you should have finished the grades. As Chief Engineer of the Chicago Engineering Works, I know exactly the kind of training you need, and I will give you that training. My course in Electricity is the most simple, thorough, successful and practical in existence, and offers every man, regardless of age, education, or previous experience, the chance to become in a few short months, an "Electrical Expert," able to make from \$70 to \$200 a week.

### Earn While You Learn

With me you do practical work—at once. In my first few lessons I show you how to make money doing Electrical work in your spare time. (Over half of my students are paying for their course in this way.) I show you also, how to get started in business for yourself, and then help you to get started.

### FREE—Electrical Working Outfit—FREE

To do spare time work you'll need tools, etc. These I give you.—Free—a whole kit including measuring instruments, a real electric motor (no toy), and other things—the greatest value ever given by any School.

### Your Satisfaction Guaranteed by a Million Dollar Institution

I absolutely guarantee to return every penny paid me in tuition if, when you have finished my Course, you are not satisfied in every way with my instruction. And back of me, in my guarantee, stands the Chicago Engineering Works, a million dollar institution.

### Nothing Like "Cooke" Training Anywhere

"Cooke" training is different because it's the most practical and most successful. It's best because it's backed up by the greatest Service to students ever known. It's this Service, plus "Cooke" training, that makes the "Cooke" trained man the "Big Pay" man everywhere. Become a "Cooke" Trained Man yourself, and earn \$12 to \$30 a day—\$70 to \$200 a week—\$3500 to \$10,000 a year.

### Investigate! Mail Coupon

Get the Vital Facts. Let me send you free my big new book on The Future of Electricity. Let me tell you more about the big demand for "Cooke" trained Electrical experts. Sign and send me Coupon below.

**L. L. COOKE, Chief Engineer**  
Chicago Engineering Works, Inc.

2150 Lawrence Ave. Dept. 34 CHICAGO, ILL.

### Some Features of Cooke Training That Make Success Certain

1. Practical Money-Making Instruction—no useless, high-sounding theory.
2. Free Electrical Outfit.—Finest outfit ever sent out for home experiment and practical use.
3. Free Unlimited Employment Service. (Helps you get a good job.)
4. Free Unlimited Consulting Service. (No chance to get stuck on anything, while studying or afterward.)
5. Free Subscription to Monthly Engineering Magazine.
6. Free use of my big Electrical Laboratory.
7. Extra Classes Free—Radio—Electrical Drafting—Automotive—Automotive Electricity—Motor Electricity and Special Lessons on Health and Thrift.
8. Spare Time Work—Special outside-you-time lessons.
9. Reduced prices on all Electrical Supplies.
10. Cash Refund Guarantee Bond.

These features are all explained in my big Free Book—the "Vital Facts."



L. L. COOKE,  
Chief Engineer,

Chicago Engineering  
Works, Dept. 34,  
2150 Lawrence Ave.,  
Chicago, Ill.

Dear Sir—Send at once the "Vital Facts" containing Sample Lessons, your Big Book, and full particulars of your Free Outfit and Home Study Course—all fully prepaid, without obligation on my part.

Name.....

Address.....

City and State.....

Occupation..... Age.....

# is the "BIG PAY" Man





# Money Making Opportunities for "Popular Science" Readers

## AUTOMOBILES AND ACCESSORIES

**PATENTS**—Write for our Guide Books, List of Patent Buyers and "Records of Invention Blank" before disclosing inventions. Send model or sketch of your invention for our free opinion of its patentable nature. Terms reasonable. Victor J. Evans & Co., 180 Ninth, Washington, D. C.

**SPEEDSTER** Bodies and equipment for Ford, particulars free. Our Book, "How to Build a Ford Speedster" on receipt of 25c. William H. Knoss, Louisville, Ky.

**AGENTS**—Automobiles amazed. Unbelievable efficiency. Patented Instrument Starts Motor, removes carbon while running, increases mileage 20-50%. Guaranteed—all engines. \$2.47 postpaid. Tremendously profitable. Investigate if you want one free. Winard Manufacturing Company, Rochester, New York.

**BUILD** a real automobile—Weight 150 pounds. Handy men or boys build at small cost. Complete Book Easy-To-Follow Plans 25c. Also sold complete. Famous 24 H. P. Shaw Motor supplies power. Stamp brings descriptive circular. Shaw Manufacturing Company, Dept. P. & 2, Galesburg, Kans.

**AUTOMOBILE PARTS**—Used parts for most any car at half factory list prices. Allen, Brisbane, Buick, Cadillac, Chalmers, Chevrolet, Dodge, Ford, Grant, Hudson, Hummer, Oakland, Overland, Oldsmobile, Reo, Studebaker and many others. Send list of parts wanted. Maxwell Bros., 4103 Olive Street, St. Louis, Missouri.

**M. P. LAUGHLIN**—Patents—Engineer—Attorney—Specializing Power-Automotive Inventions. 48 East 41st St., New York.

**MONEY**—Silvering autolights, radiators, mirrors. Refurbishing tailwheels, fenders, bumpers, etc. Perfect. Methods free. Write—Sprinkle-Plaster, Dept. 94, Marion, Indiana.

## FORD ACCESSORIES

**SPEEDSTER** fans—see "Red-i-Kat" ad, page 184.

## MOTORCYCLES, BICYCLES, SUPPLIES

**DON'T** buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galesburg, Kansas.

**DON'T** pay \$50 for bicycles, buy motor cycles \$50 to \$100. Easy terms. Pay as you ride. Non skid Ford tires \$3, tubes \$1.25. Bicycles, motor cycles at factory prices; talking machines at half price. Records 10c. Send 10c in stamps for catalogue. Deinger Price Cutter, Rochester, New York.

**OVERHAULED**—200 Used Motorcycles. Must be sold at once. We have Harley-Davidsons, Indians, Hendersons, Kaelins, Clevelanders. Prices \$35.00 up. Write for our Bargain List. Myerow Brothers, Dept. C, 15 Berkeley St., Boston, Mass.

**BIGGEST** stock of used Motorcycles in America. Rebuilt and look like new. Indian Motorcycles Sales, 1331 Jackson Blvd., Chicago.

**LARGEST** Assortment of Used Motorcycles and Parts in America. Lowest Prices. Indian Motorcycles Sales & Service Co., 1331 Jackson Blvd., Chicago, Ill.

**INDIAN** Motorcycles run 2000 miles—\$95.00. Engines, \$14.00. Nathan, 104 Colvin St., Baltimore, Maryland.

## MODELS AND MODEL SUPPLIES

**WE** make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

**MODEL** making and experimental work; modern shop, expert workmen. Manufacturing. Lamm M. & Mfg. Co., 525 W. Jackson, Chicago.

**MODELS** and tools made to order. Schmidt, 304 Canal Street, New York.

**WE** Build Models, design, develop, and manufacture articles in large or small quantities. Homsey Machine Products and Mfg. Co., 1365 E. 17th St., Cleveland, Ohio.

## MOTORS, ENGINES, MACHINERY

**MOTORS**—D. E. R. H.P. \$15.00; 5 H.P. \$32.50; 1 H.P. \$32.50. Generators, 5 volt, 10 amp., \$15.00; 25 volt, 500 watt, \$30.00. Other sizes, low prices. Motor Specialties Co., Crafton, Pennsylvania.

**STEPHENS** medium priced line of Shapers, Milling Machines, Lathes, and Die Motters will reduce your manufacturing costs. Established since 1845. Catalog upon request. The John Stephens Company, Camp Washington, Cincinnati, Ohio.

**BLUR** Generators, brand new, 6 volts, maximum output 22 amperes at 2000 r. p. m. Government paid \$45.00 each, our price \$10.00. General Sales Company, 1921 S. Michigan Avenue, Chicago, Illinois.

**ONE** 16"x30" Pratt and Whitney Planer, \$175. One 11"x14" Artisan Lathe new, \$150. One 20" drill press, \$95.00. Complete line machinery and supplies. Cincinnati Machinery Supply Co., 217 E. Pearl Street, Cincinnati, Ohio.

## SHOP EQUIPMENT

**CIRCULAR** Saw for bench. Write Box 17, Hackensack town, New Jersey.

**LATHES**—We must sell our stock of 137 bench lathes, being 7 in. Between centers, 18 in. Ideal for the experimenter or inventor. Not a toy. Special price, \$42.50. Write for details. Mechanical Equipment Co., 150 No. Wood St., Chicago, Ill.

## AVIATION

**PROPELLERS** for aeroplanes propeller, 6-foot diameter, \$12; 6-foot for Ford, \$15; others in proportion. Motorcycles, sketch blueprint, 75c; Ford Size, \$1.00. Pictures free. Crawford Motor and Aeroplanes, Long Beach, California.

## Another \$25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:—

**What advertisement of "Money Making Opportunities" in this issue interests you most and why?**

Here are the prizes we will pay for the ten best letters answering the above question:—

First Prize . . . . . \$10.00  
Second Prize . . . . . 5.00  
Third Prize . . . . . 3.00  
And 7 Prizes  
of \$1.00 each . . . . . 7.00

First read every one of the "Money Making Opportunity" advertisements on pages 8 to 26. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, not more than seventy words, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before April 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the June issue. Address your prize letter to

Contest Editor

POPULAR SCIENCE MONTHLY  
225 West 39th Street, New York City

## Last Month's Prize Winners

The First Prize of \$10.00 goes to Miss M. K. Clark of Tifton, Ga., for her letter on the advertisement of Mr. Sinclair. Here is Miss Clark's letter:—

Dear Sir:—  
Mr. Sinclair's advertisement under the heading "Insects Wanted" interests me most because it offers me an opportunity to turn an interesting pastime and hobby into a source of profit. Also, it has suggested to me a motive which I may use to catch the interest of some of my Nature Study pupils who are inclined to think "they ain't no sense in studyin' 'last bugs."

MAE K. CLARK.

Mr. W. F. Sandmann, of Indianapolis, Ind., wins the second prize for his letter on the advertisement of the Lightning Calculator Company.

Dear Sir:—  
The ad of the Lightning Calculator Company interests me particularly. I had noticed this same ad for salesmen before in your pages and when one of my men approached me this week I bought a Calculator—partly because I realized reading their ads for "live" men—partly because this man strictly "filled the bill." And he admitted that he was connected with his employers by the "Money Making Opportunities" section.

W. F. SANDMANN.

The Third Prize goes to Mr. John H. Brown, Atchison, Kansas.

The Winners of the other seven prizes are:—

Mrs. E. S. Pflieger, Iowa City, Iowa; J. M. O'Hara, Montana; Mrs. D. W. Wells, Danville, N. Y.; Louis Cohen, Peabody, Mass.; Anna M. Kerpinski, Erie, Pa., and P. L. Flyter, Danville, Va.

Rate 25 Cents a Word. Advertisements intended for the June issue should be received by April 5th.

## RADIO AND SUPPLIES

**RADIO** generators 500 V 100 Watt \$28.50 each. Battery chargers \$12.40—High speed motors. Motor-Generator sets, all sizes. Motor Specialties Co., Crafton, Pennsylvania.

**YOU** don't need tubes to get out of town. If you want new stations on your crystal set, write me today. Mine works 400 to 1,000 miles without tubes or batteries! Thousands have bought my plans and now get results like mine. Changes often cost less than dollar. Send self-addressed envelope for further information. Leon Lambert, 555A So. Volusia St., Wichita, Kansas.

**CRYSTAL** Radio Receiving Set. Guaranteed. Only 50c postpaid. Dealers wanted. Tru-Bin Supply Co., 104 Lake Ave., Rochester, N. Y.

**WANTED**—Representative in every town. Small investment. Large profits. Write for particulars to Ray-Dun-Artificial Instrument Co., Redlands, Calif.

**AUTOPLEX** Circuit, operates loud speaker on one tube. Complete parts, panel, tube, and diagram, \$15.50; other sets \$10.00 up. Neutrodyne 5 tube mounted un-wired, \$49.47. Catalogue free. Royal Mfg. Co., Dept. 308, 296 Broadway, New York.

**LOUD** Speaking Crystal Set. Broadcastings heard throughout house. Easily constructed. Instructions complete 25c. Catalog free. Westminster Wireless Mfg. Co., 5810 Penn Ave., Pittsburgh, Pa.

**ARMSTRONG** Regenerative Receiver (Licensed) 500 to 1000 miles distance, complete with tube, phone, batteries, aerial, \$28.75. Cash with order. William Gibson, 525 Palace Building, Minneapolis, Minn.

## ADVERTISING

**ADVERTISE** in 24 metropolitan dailies, 24 weeks, \$15.00. Helpful Guide listing 1000 publications, 40 stamps. Wade Company, Baltimore Bldg., Chicago.

**ADVERTISING** rates for magazines and weeklies free. Charles A. Lutz, Apartment 241, York, Pennsylvania.

**24** WORLD combine list of 70 Sunday and weekly newspapers, \$8.00. Advertiser, 4112P, Hartford, Ct., 1926.

## ADVERTISING NOVELTIES

**GIFT** letters Advertising-Pencils for you. Buy direct, save entire middleman's profit. Samples free (no agents). Address R. Munst & Co., 10-14 Lincoln St., Yonkers, N. Y.

## DUPLICATING DEVICES

**"MODERN"** Duplicators save Time, Labor and Money. Gets business. Reproduces Typewritten or Printed Letters, Drawings, Lemons, Music, Menu, Bills, Notices, Specifications, Maps or anything in one or many colors. Prints two per minute. Special sale on 30 days free trial, \$2.25 up. Booklet free. J. V. Durkin-Reeves Co., Pittsburgh, Pennsylvania.

**STENCIL** Duplicating Unit—\$2.00, \$3.00, \$4.00 sizes. Prints Typewritten and Handwriting. On approval. Primus Specialty Co., 3-5 Primus, Pennsylvania.

## TYPEWRITERS AND SUPPLIES

**TYPEWRITERS** all makes. Save one-half. Thoroughly rebuilt in our factory by the famous "Young Process." Fully guaranteed. Free trial. We handle all standard makes. Cash or sell on easy terms. Write for Catalog. Young Typewriter Co., Dept. 5094, Chicago, Ill.

**ALL** makes, rebuilt, refinanced and guaranteed two years. \$15.00 up shipped privilege 30 days' time. Get our prices and agents proposition. Typewriter Manufacturers Exchange, Fordham, New York.

## LABORATORY AND CHEMICAL

**EXPERIMENTERS**. Complete supplies for the chemical laboratory. Catalogue 6c. National Scientific Supply Co., 241 Pennsylvania Avenue, Washington, D. C.

**YOUR** chemical problem solved and working process furnished for five dollars. Write me, W. Siedman Richards, Consulting Chemist, Box 2402, Boston, Mass.

**BE** a Laboratory Expert. Earn \$100.00 to \$500.00 monthly. Study Bacteriology, Sanitation, Interesting Extension, Residential Course, Diploma and Degree granted. 70 Piece Urinalysis Outline Free to Students. Write for free Prospectus today. International Pharmacy and Surgeons College, Room 929, 550 Oakfield Ave., Chicago.

**SEE** Hadium Rays using our \$1.00 Spinthariscopes. Laboratory apparatus, chemicals. Send for bargain prices. Washington Scientific Company, 2109 Fourteenth Street, Washington, D. C.

**PRODUCTS**, formulas duplicated, improved, cheapened. Elkind, Harding, P. O. 1020 S. Chicago.

**CHEMICAL** and Bacteriological Examinations Guaranteed Accurate. Research Work, Formulas, Processes, Trade-Receipts, all done. Work guaranteed. List free. J. F. Mann, M.B., 1027 W. 20th St., Lorain, Ohio.

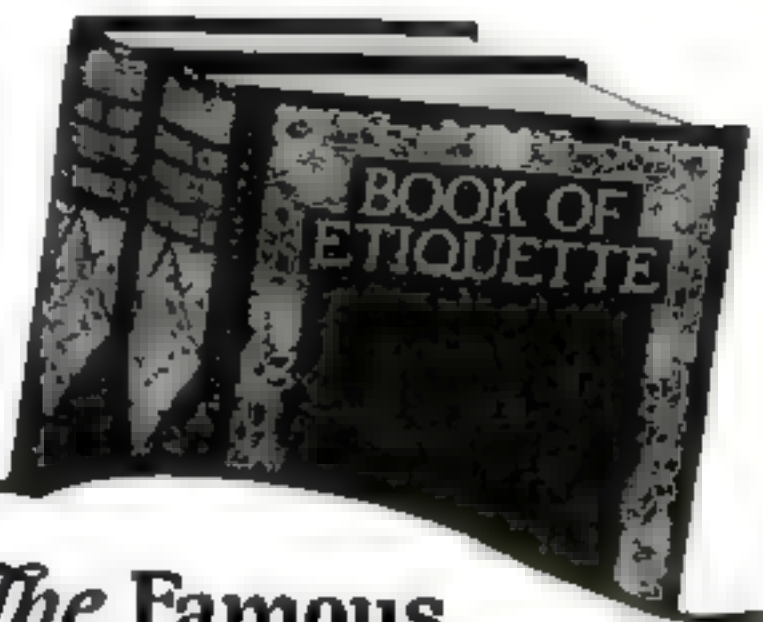
## AMERICAN MADE TOYS

**MANUFACTURERS** on large scale, also homeworkers wanted to manufacture metal toys and novelties. Millions needed of barking dogs, wag tail pigs, wild animals, automobiles, Indians, cowboys, baseball players, cannons, toy soldiers, crowing roosters, Statues of Liberty, miniature models of capital, bathing girl novelties and others. Unlimited possibilities. Guaranteed casting firms furnished manufacturers at cost price from \$5.00 up, with complete outfit. No experience or tools necessary. Thousands made complete per hour. We buy goods all year and pay high price for finished goods. Cash on delivery. Contract orders placed with manufacturers. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1698 Boston Road, New York.

**More Money Making Opportunities on pages 10 to 26**



# For the Last Time!



## The Famous Book of Etiquette ONLY \$1.98 If You Act Quickly



"Goodbye! I'm Very Glad to Have Met You."

But he isn't glad. He is smiling to hide his confusion. He would have given anything to avoid the embarrassing moment he has just experienced. If only that polite little book had been with him to guide him through the situation. He had no idea how to act. But you know what to do!



Again She Orders—  
"A Chicken Salad, Please."

She hears herself give the order as in a dream. She hears him repeat the order to the waiter in a rather surprised tone. Why HAD she ordered that again? He would think she didn't know how to order a dinner. Well, did she? No. She wasn't sure of herself. She didn't really KNOW.



What's Wrong in This Picture?

It is so easy to make embarrassing mistakes in public. There is, for instance, the very obvious mistake that is being made in this picture. Do you know what it is? Can you point it out? Perhaps there are more mistakes than one—what do YOU think?

**L**AST call! This is positively your final chance to secure through these pages the complete, original \$3.50 edition of the famous two-volume Book of Etiquette at the special bargain price of only \$1.98.

Half a million men and women have paid the full publishing price of \$3.50 for these two helpful volumes. Almost as many have taken advantage of the \$1.98 bargain price. Now we are offering you for the last time—the original, complete \$3.50 edition of the famous Book of Etiquette for only \$1.98 during the life of this announcement. You must act NOW.

You have always wanted to own the famous Book of Etiquette. You have always wanted to have in your home the two remarkable books that solve every social problem, that protect from embarrassment, that prevent impulsive blunders. Here is your opportunity—your last opportunity—to secure the original \$3.50 edition for practically half. Are you going to let the chance slip by?

### The Silent Secretary in Your Home

The Book of Etiquette is being used daily by hundreds of thousands of men and women. It is a silent social secretary that tells the precise thing to do, say, write and wear on every possible occasion. It omits nothing. It forgets nothing. It eliminates all chance for blundering, protects from all embarrassment and humiliation in social contact, gives you a wonderful new ease and poise of manner.

Why wonder when you can know? Why hesitate when you can be certain? Why be embarrassed and uncomfortable when you can be thoroughly at ease? Let the Book of Etiquette be your silent advisor. Let it tell you when to entertain and how. Let it tell

### Send No Money

Thousands of people will take advantage of this last great opportunity—and you are urged to act promptly. When the present edition is exhausted, it will not be reprinted. You must act at once, NOW.

No money is necessary. Just clip and mail the special coupon. But be sure to mail it at once, while you are thinking of it. Remember—this edition will never be offered in these pages at \$1.98 again. This is the very last time!

you what to do, what to say, on every occasion of social uncertainty. Let it give you poise, ease, dignity, self-confidence.

And remember—this is positively your last chance to secure this famous edition for only \$1.98.

### An Armor Against Embarrassment

Etiquette is the armor that protects us from little unexpected embarrassments. A spoon incorrectly used. Olives taken with the fork. An introduction wrongly acknowledged. A dance or party at which one feels "alone," out of place. A tea at which one is "tongue-tied"—unable to converse pleasantly, and be in do or say with ease the things that are correct.

These are the things that invariably cause us great embarrassment. And they can be avoided! You can know just what to do and say on every occasion. Etiquette will protect you from making impulsive blunders, will be an armor that guards you from embarrassments and humiliation. Etiquette will make you a better "mixer," a better conversationalist; it will make you sure of yourself, confident of your own social powers.

Why attempt to conceal embarrassment when you can have the lifelong comfort of ease? Why wait longer when you are being offered the last opportunity to secure through these pages the original \$3.50 edition of the Book of Etiquette for only \$1.98?

Here's the coupon—clip and mail it TODAY. Nelson Doubleday, Inc., Dept. 254, Garden City, New York.

NELSON DOUBLEDAY, Inc., Dept. 254, Garden City, New York.

I want to own the famous two-volume set of the Book of Etiquette. I am taking advantage of your last offer to readers of Popular Science. I want this \$3.50 edition for only \$1.98. You may send the two books to me at once and when they arrive I will pay the balance only \$1.98 (plus few cents delivery charges in full payment). It is understood, of course, that I may return the books any time within 5 days and have my money refunded in full.

Name \_\_\_\_\_

Address \_\_\_\_\_

Check this square if you want these books with the beautiful full-leather binding at \$2.98 with same return privilege. Last chance!

Orders from outside the U. S. are payable \$2.44 cash with order. Leather binding, outside U. S. \$3.44, cash with order.







# ALL-WOOL

## 3-Piece Fancy Serge Suit

Save  
**\$12<sup>50</sup>**

**Only**  
**\$100**  
**DOWN**  
**6 Months to Pay**  
**Total Price \$27<sup>85</sup>**

**Was \$40<sup>00</sup>**  
**Now \$27<sup>85</sup>**

Now for a winner! Save \$12.50 on your early Spring Suit. A \$40.00 Spring Suit, only \$27.85. An All-Wool (Virgin Wool)—a suit well-tailored—a suit that we recommend with a binding Guarantee. It is made of a beautiful black and brown check suiting, lined with good alpaca and trimmed with the best of everything. Get in on this remarkable value right away. We ship the suit subject to your approval. If you are not satisfied in every way, just send it back. If you are satisfied in every way, as thousands of others have been, pay for it on our easy monthly terms. Absolute satisfaction guaranteed and our Iron-clad Guarantee that the suit is all wool.

These suits are all wool, checked suiting. Business men's model—three piece—coat, pants and vest. The coat is cut in the most conservative and dignified style. It is made in the latest three button style, easy fitting, full lined, medium weight for all seasons. Vest has 5 buttons and no collar. Pants can be worn with or without belt. Sizes 34-46 breast, Trousers 29-44 inch waist. Order by No. 5746.

We have this same suit in the young men's style—latest model and very snappy—as shown in upper left hand corner. A two button, narrow shoulder form fitting coat, skeleton lined. Pants made for belt only. Vest cut regular. Sizes 34-42 breast measure. Trousers 29-42 waist. Order by No. 5747.

**Pants May Be Had With or Without Cuffs**

State size of suit if you know it—if not, be sure to give your weight, your chest measure, taken over vest for coat. Waist and an inseam measure for Trousers.

### Extra Special Offer! *Doubles the Life of Your Suit!*

With every order for a suit received from this advertisement, we will send an extra pair of pants like your suit **AT COST**, only \$8.88. This does not increase amount you pay per month.

## Order Today!

You can't afford to miss this chance to get a high-grade, all-wool worsted suit, suitable for all year around wear at this astounding bargain price. If you are not absolutely satisfied, your money will be cheerfully refunded; you take no risk. If satisfied, you have 6 months in which to pay. Fill out the coupon and mail it with just one dollar. But do it right away.

**BABSON BROS., 19th St. and Marshall Blvd., Dept. 13-64 Chicago, Ill.**

Enclosed please find \$1.00. Send me the three piece Whitman worsted suit at advertised price. If I am not satisfied when I receive the suit I can return it and get my money back. If satisfied, I will pay the advertised rate of \$27.85—payments to be made \$5.00 monthly. I understand that extra trousers will be an additional \$5.50.

My weight is \_\_\_\_\_ My measurements are: Coat (chest over vest)...

Trousers (waist, \_\_\_\_\_ In waist, \_\_\_\_\_) Trousers (check) with cuffs ☐ without cuffs ☐

Order No. (Check) 5746 ☐ 5747 ☐ Extra trousers (check) ☐

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Age \_\_\_\_\_

Occupation \_\_\_\_\_







# New Kind of Hat

## Worn 10 Minutes a Day

# Grows Hair

## in 30 Days

# —or No Cost

No matter how thin your hair may be this remarkable new scientific invention is absolutely guaranteed to give you a brand new growth of hair in 30 days—or it costs you nothing. Don't send a cent. Just mail coupon below.

By ALOIS MERKE

Founder of Famous Merke Institute, Fifth Ave., N. Y.

I HAVE perfected a new invention that I absolutely guarantee will give you a new head of hair in only 30 days—or the trial costs you nothing.

This new invention—the result of an experience gained in treating thousands of cases of baldness—is in the form of a new kind of hat. It is worn on the head just 10 minutes a day. No unnecessary fuss of any kind. Just put the hat on your head. Wear it 10 minutes. And that's all there is to it.

Sounds impossible, doesn't it? All right. Then let me emphasize this fact. I don't care how thin your hair is. I don't care how many treatments you have taken without results. Unless my discovery actually produces a new growth of hair on your head in 30 days, then all you need do is tell me so. And without asking one question, I will instantly—

and gladly—mail you a check refunding you every penny you have paid me.

### How It Works

My invention is entirely different from anything known or used before.

It proves that in a big percentage of hair troubles the hair roots are NOT dead, but merely dormant!

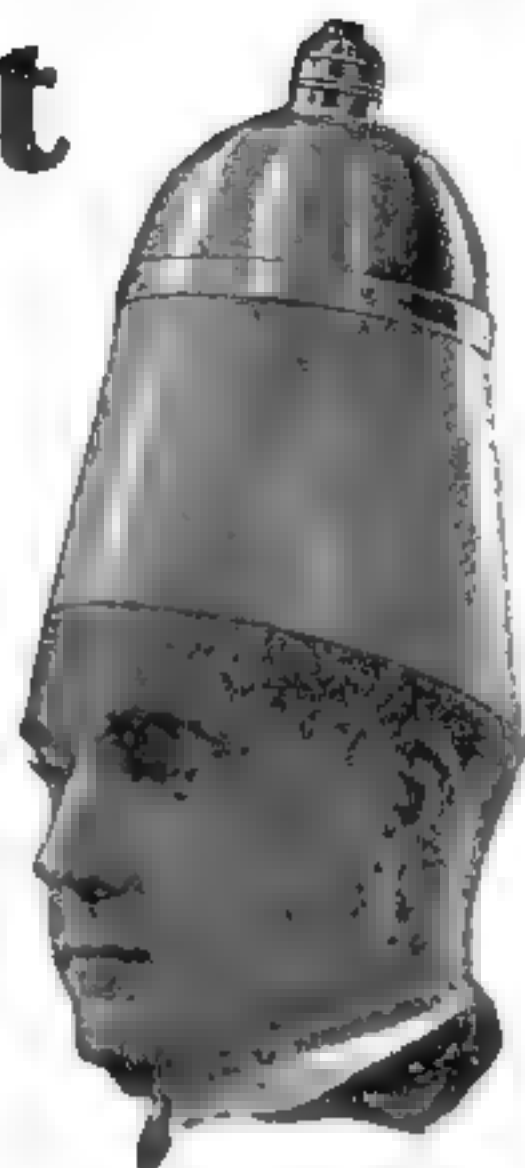
The reason ordinary measures failed to restore hair is because they merely treated the surface skin. My new invention goes further. It gets right to the cause of most hair troubles—the starving dormant roots.

Your hair grows just as a tree grows—from the roots. To make a tree grow you wouldn't rub "growing fluid" on the bark. Instead you would nourish the roots. And my invention provides, at last,

not only an efficient way of stimulating these dormant roots, but of giving them the nourishment they need to grow hair again.

### No Risk of Any Kind

At the Merke Institute, Fifth Avenue, N. Y., which I founded, stage and social celebrities have paid as high as \$500 for the results secured



through personal treatments. Yet now, through my new invention, these results may be secured in any home where there is electricity—for just a few cents a day!

Remember—I don't ask you to risk a cent. I realize that my treatment will not grow hair for EVERYBODY. There are some extreme cases of baldness that nothing in the world can help. But my new invention has already grown new hair for so many hundreds of others who had long ago given up hope that I am willing to let you try it entirely at my risk, and if it fails then I lose—not you.

### Free Booklet Explains Invention

If you will merely fill in and mail the coupon below I will gladly send you—without cost or obligation—an interesting 32-page booklet, "The New Way to Make Hair Grow," describing my new invention in detail.

This booklet contains much helpful information on the care of hair—and in addition shows what my treatment is doing for thousands of others.

No matter how nearly bald you are—no matter how many treatments you have tried without results—this booklet will prove of deepest interest to you. So mail the coupon now—and it will be sent you by return mail. ALLIED MERKE INSTITUTE, Inc., 512 Fifth Avenue, Dept. 174, New York City.

Allied Merke Institute, Inc.  
Dept. 174, 512 Fifth Ave., New York City.

Please send me, without cost or obligation on my part, a copy of the new booklet "The New Way to Make Hair Grow" describing in full detail the Merke Institute Home Treatment.

Name \_\_\_\_\_  
(State whether Mr., Miss or Mrs.)

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

### What Users Say

"I have been bothered with dandruff for twenty years and had lost nearly all of my hair. I have used your treatment 10 days and now have a great growth of hair coming in. I cannot say too much in praise of the Merke Treatment."  
C. H. B.

"Treatment positively shows quick results. After five weeks' treatment a new growth of hair has shown on each side of the temple, where I have been bald for years."  
C. B.

"Am glad to say I can see such great change in my hair. It is growing longer and my head is full of young hair that has made its way through place I have been using Merke Treatment. I can't say enough for it. It will do every thing you claim it to do."  
Mrs. C. G.

"After using the Merke Treatment as per your instructions, my scalp is now showing improvement daily and a chunk in time I will have more hair than I had two years ago. I was practically bald on the top, but now it is gradually filling in from the back."  
J. S. W.







# How to Invent— What to Invent and What to Do About Protecting and Selling An Invention

**A**LTHOUGH the fact has been universally recognized that invention is governed by a few simple, easily acquired, fundamental principles, no one ever thought of putting these principles in black and white so that everybody interested in invention could read them. In spite of the fact that Thomas A. Edison made his famous statement that invention should be taught as a science, thousands of people continued to work blindly, doggedly, haphazardly to perfect their ideas.

But now anyone can learn how to invent. Fifteen famous inventors have at last given to the world the laws and principles of Inventive Science. They have shown every ambitious man and woman how to invent. They are teaching invention exactly as other people are teaching law, medicine, bookkeeping. Instead of spending years groping blindly, instead of wasting your time in useless, heartbreaking drudgery, you learn how to complete your ideas quickly and what to do about them when they are completed. You learn how to think so you are sure to succeed.

## Everybody Invents

For a long time it was commonly believed that every invention was a matter of pure luck—the result of some happy inspiration that suddenly flashed through a man's brain, and which made him fabulously rich without the slightest effort or thought. But you can prove for yourself that this is not so. You can prove for yourself that invention is the result of thinking and action along definitely exact, scientific lines.

Suppose when you went home tonight, you found a window rattling. Through your mind would flash, almost instinctively, a regular order of thoughts which characterize the conception and completion of every invention the world has ever known. First, you would recognize a problem to be solved—the rattling of the window. Then you would think of several principles of science or mechanics which would solve your problem. You might think of the scientific fact that if you poured water on the frame the wood would swell and tighten the window. You might think of using a nail. But what you most probably would do would be to use the oldest mechanical principle known to man, the wedge.

## What Invention Is

Brought down to its simplest terms, that is exactly the way every invention has been made—combining two ideas; a problem

—How to develop your imagination  
—How to develop your ideas  
—How to get the facts you need for inventions  
—How to keep legal records of ideas  
—How to use scientific principles of mechanics  
—How to avoid wasting time on impractical inventions  
—How to apply for a patent  
—How to organize a company  
—How to protect your rights  
—How to market a patent  
and hundreds of other vitally important facts which EVERY successful inventor knows and uses.

which must be solved and a fact of mechanics or science which solves the problem. So, although you may never have thought of it in just this way every time you solve a problem in your daily life—at home, traveling, or in business—you are an inventor; you use the principles of thought and action which govern the Science of Invention!

You can see, therefore, how easy it is for you to develop your natural instinct to "fix things." The same processes of thought that almost instinctively told you to fix a rattling window with a wedge can be so well developed that you can learn to invent other things almost as easily and quickly. You know, too, that every invention is made only by thinking inventively. And every inventor is agreed that the principles of Inventive Science are so simple, so easy to learn that anyone,

regardless of training or education, can develop himself to become a successful inventor!

With every new advance, with every new discovery that the world experiences, more problems are coming up—and more inventions are needed to solve these problems. Now, as never before, are new inventions wanted, and the world will pay a fortune to the man or woman who gives it just one of the inventions it needs.

Even little ideas can bring you a fortune. Eberhard, who invented the rubber on the end of a pencil, has been paid hundreds of thousands of dollars for his simple idea. The man who invented the metal tip for shoelaces, the man who conceived the idea of the "bumped" hairpin, the man who developed the metal tape measure, all have achieved success and wealth as great or greater than the inventors of large machinery.

## Learn How to Invent at Home

If you would like to develop your natural inventive ability along money-making lines, instead of trifling with ideas—if you would like to DO something about your

ideas instead of letting someone else patent and market them ahead of you, let this great Course in Inventive Science help you. Get the advice and help of the fifteen famous inventors who tell you the secrets of invention which you MUST know to be successful.

This is the first course in practical invention that has ever been devised. In simple, easy-to-understand language you are told how successful inventors work; you learn how to think along inventive lines, you learn the short-cuts to successful invention, you learn how to use the secrets of invention that convert a simple little idea into money.

No one step in invention has been omitted. Everything you want to know about invention—developing your ideas, securing information you need, how to apply for patents, how to protect your rights, how to sell your invention—are taken up step by step, so that when you have completed the course you have a wealth of information worth thousands upon thousands of dollars.

## FREE—New Book on Inventive Science

A wonderful new book has just come from the press that tells you all about the Science of Invention. It tells you how to avoid the pitfalls that have brought failure to thousands of would-be inventors. It tells you how to learn the secrets of practical invention, which famous inventors discovered only after years of heart-breaking effort and discouraging mistakes, and it tells you how to do this in only fifteen minutes of your spare time each day. This fascinating book will be sent to all those who are genuinely interested. Get the advice of those fifteen famous inventors. Let them tell you how you can easily learn the secrets of successful invention. Send for this Book today as only a limited number are available for free distribution. Send the coupon below NOW, or a letter or postal card will do. There is no cost or obligation. This bureau is not connected in any way with patent attorneys or manufacturers. Our only work is to help ambitious men and women to develop their inventive ability—to become successful inventors.

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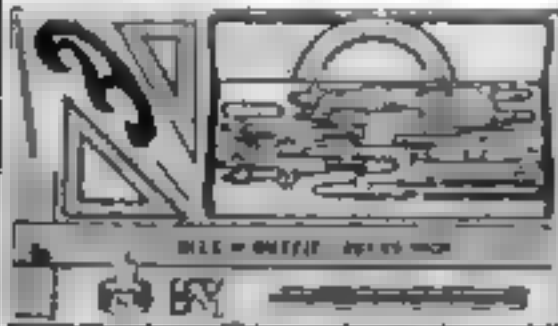
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More Money Making Opportunities on pages 2 to 26











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**More Money Making Opportunities**  
on pages 8 to 26

**More Money Making Opportunities**  
on pages 8 to 26



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April 2

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April 10

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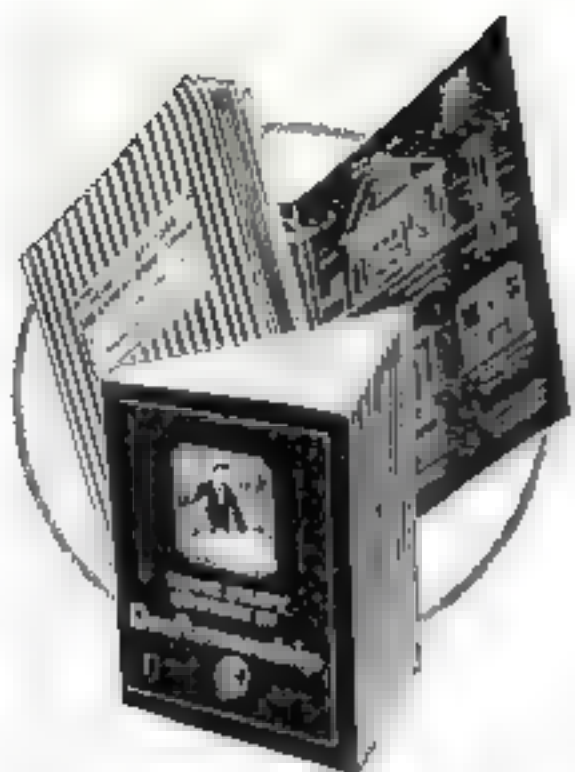
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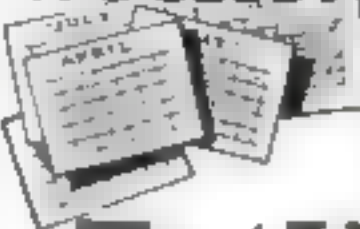
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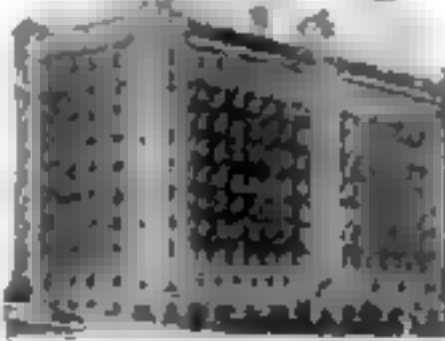
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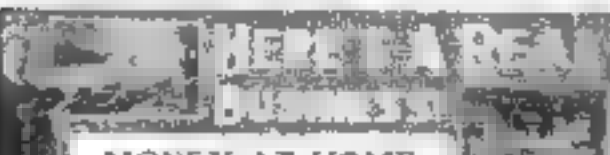
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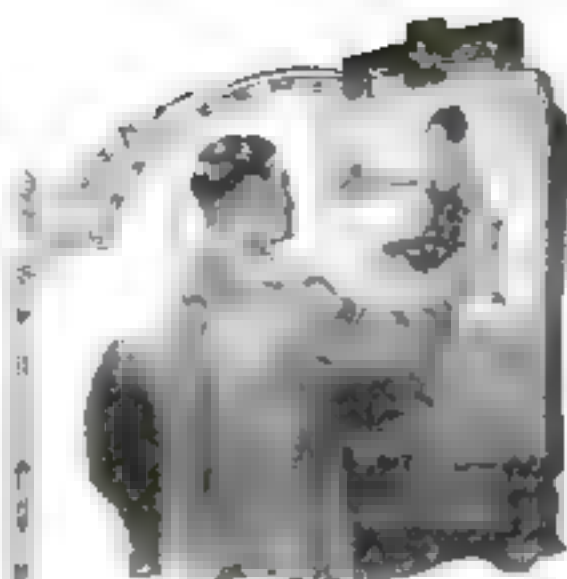
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- |  |   |  |
|--|---|--|
| 1. What is color, and what makes white light?  | 5. What are multiple personalities like <i>Dr. Jekyll</i> and <i>Mr. Hyde</i> ? | 9. Why is it that animals cannot learn to talk?                    |
| 2. Why can dynamite be burned without exploding?   | 6. Why are the nights likely to be cold in the desert?                          | 10. What causes plants or animals to reproduce themselves exactly? |
| 3. What is the Milky Way and why are the stars thicker in the Milky Way than elsewhere in the sky? | 7. How is a broken bone mended by the body?                                     | 11. Why does damp hay in a barn sometimes take fire?               |
| 4. What makes food mold?   | 8. What is the difference between a storage battery and a dry battery?          | 12. Why do spiders not get caught in their own webs?               |

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# Rocket to the Moon

By F. Gregory Hartswick

IF THE proposed transpolar flight by airship is completed successfully, almost the last unexplored region of the earth will have been charted and mapped. In the restless wanderings of man over this globe only a few square miles have been left untrodden. The eternal spirit of "something lost behind the ranges" has driven men from time immemorial to seek what lies in the unknown regions.

And now the earth's last hidden territory to the north is about to yield its secrets. Where will the restless force of adventure drive man next?

There is a territory not far away, as distances go in space—a territory explored by the eye of man, mapped, named, and described—a territory that, through the powerful eye of the modern telescope, has been brought to within a theoretical distance of 60 miles and yet which, up to the present moment, never has been reached by man. It is the earth's satellite—the moon. Toward this land



Years ago Jules Verne told of a hollow cannon ball that carried passengers from the earth to the moon. More recently Professor H. Oberth, of Rumania, suggested the possibility of a passenger-carrying rocket such as our artist has visualized on this page. Far less imposing and fantastic is Professor Goddard's moon rocket, described in the accompanying article, yet his invention at least is based on a hypothesis of scientific practicability and so has compelled the attention of scientists. Who knows but that his modest attempt to photograph the blazing trail of a missile shot through the vault of heaven may be a pathfinder for future achievements in interworld communication?

The eye of the scientist and explorer has been turning hungrily. And today their indomitable spirit, in the person of Professor R. H. Goddard, of Clark University, Worcester, Mass., plans to hurl into space a rocket that will bridge the 240,000-mile gap separating us from our nearest heavenly neighbor. He plans to make his experiment early in the coming summer.

Man, in his own mind, has been traveling to the moon ever since the tellers of tales realized that the ideal field for romance lay in the lunar satellite. All a writer had to do was to invent a suitably plausible method of reaching the moon, and, presto! His hero was safe where the most violently impossible things could happen.

Rostand's immortal *Cyrano de Bergerac* made the trip, according to his own account, by sitting on a piece of iron and throwing a magnet into the air. "The magnet thrown," says the gallant Gascon,

Infallibly the iron must pursue—  
Then quick! Relaunch your magnet, and you mount  
Unmeasured distances!

The good *Cyrano's* plan is not to be recommended to possible lunar explorers.

Edgar Allan Poe's *Hans Pfaal* made a successful journey to the moon in a balloon filled with a gas, the









## Motorized Rapid Transit in the Far North

**T**HE march of science into the frozen expanses of the Far North is bringing a new era of rapid communication across the wildernesses of snow. Mail planes equipped with landing skis, and swift, motorized sleds soon may replace the picturesque dog teams, just as the motor car is replacing the camels of

the desert. Our artist has pictured above these possibilities of arctic rapid transit.

The United States Post Office Department recently announced plans for airplane mail service from the terminus of the Government Railway at Nenana, Alaska, to Fairbanks. Thus a 20-day delivery service by dog team will be sup-

planted by a four-hour air mail service.

At the same time an ingenious motorized sled has made its appearance at Helsingfors, Finland. The machine is propelled by a motorcycle engine belted to a bicycle wheel. The contact of the rubber tire with the snow is said to create sufficient friction to drive the sled forward.



# Broncho-Busting the Wild Colorado

## A Race with Death through Scething Rapids

By George Dacy

**S**CIENCE has stormed successfully the last bulwark of Nature in the United States.

A few weeks ago an exploration and surveying party of the United States Geological Survey, headed by Col. C. H. Birdseye, completed the work of surveying and mapping the Colorado River through the Grand Canyon—a 450-mile swirling stretch of the wildest water in the world. Though the mapping of the Colorado has been in progress since the days of Abraham Lincoln, those who previously ventured into this portion of the river had been frustrated in their attempts to survey it. Few daring explorers had navigated it successfully.

Ten men made up the recent surveying party—one of the nine who started being replaced by another during the trip. In the 77 days required to accomplish the mission, Death almost constantly reached out from the mad white waters to seize their boats and hurl them to destruction against the jagged rocks.

### A Racing, Rioting Torrent

Imagine the fury of a Niagara concentrated in a narrow winding channel cut through solid rock that rises a quarter to half a mile in the air, and you will have a faint idea of the racing, rioting torrent on which the explorers rode with the speed of an arrow. Yet beyond their breathtaking adventures, the scientific value of the exploration is paramount in interest.

Millions of horsepower constantly are going to waste in the tempestuous waters of the Colorado. California and Arizona have in project dozens of irrigation schemes, the potential success of which is entirely dependent upon the harnessing of the river to the needs of modern civilization.

Corralled and subdued to the service of man, this wild-flowing stream would supply Los Angeles with a constant source of power, insuring the industrial future of the city. The copper mines of Arizona, containing some of the richest copper deposits in all creation, and now operated by steam power developed from oil burners, could increase their yield immeasurably.

Uncle Sam's expedition just completed blazed the path that eventually must lead to these accomplishments. From the standpoint of science and of the industrial advancement of the Far West, a most important part of the explorers' work was the surveying of 20 sites suitable for large power dams on the 450-mile course



Uncle Sam's engineers making a plane table survey while the "white water" rushes about them. Despite difficulties of setting instruments, the survey of the river was completed.

**M**ORE than 6,000,000 horsepower—equal to half the electric power in the country today—is constantly going to waste in the wild, unbridled waters of the Colorado River through which Col. C. H. Birdseye and his party of government surveyors made their mad dash of exploration.

It was to pave the way for the capture and use of this tremendous power, as well as for the development of a vast territory by irrigation and cultivation, that the government explorers braved unknown canyon depths.

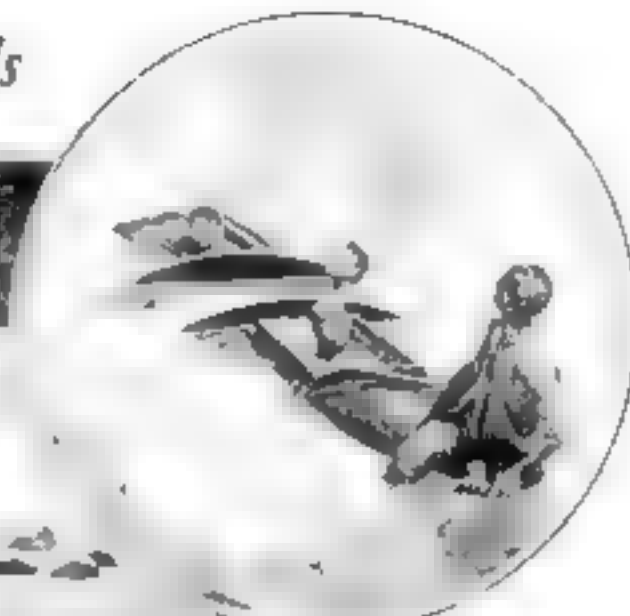
Their achievement is far more than a thrilling adventure. It is an important contribution of scientists to the development of America's natural resources.

where the Colorado rages most fiercely and runs most swiftly.

The uncharted stretches of the Colorado had been a thorn in the side of the Geological Survey for more than half a



This boat has been hoisted high up the bank and lashed to the slope to prevent its being swept away by a sudden flood that caused the Colorado River to rise 23 feet in one night.



One reason why the hazard was regarded as less successful was the fact that the party's gun, in a way, was useless, and the passengers were not actually captured. They had many laughs and jokes as something to laugh at.

century, and Uncle Sam decided upon a supreme effort to conquer them. Four specially constructed wooden boats and one canvas canoe were mobilized for the expedition, for an ordinary rowboat in those turbulent waters would have survived about as long as a paper craft would in a millrace.

Next, daring, seasoned men were selected for the party. Besides Colonel Birdseye were E. C. LaRue, a hydraulic engineer, who for several years had been studying the problem of utilizing the waters of the Colorado; R. C. Moore, state geologist of Kansas; R. W. Burchard, a Federal topographical engineer, who previously had surveyed the lower stretches of the river; Emory C. Kolb, of Grand Canyon, an expert boatman; L. R. Freeman, explorer and boatman of California; two more boatmen, and a cook.

The rigors of the extraordinary journey began as soon as the party left the railroad at Flagstaff, Ariz. Thence the equipment was carried by motor truck 140 miles over some of the roughest roads under the sun. Lees Ferry was the take-off point of the perilous river trip. A radio receiving set was carried—the party's only means of keeping in touch with the outside world.

### Lifelines in Daily Use

One skilful boatman guided each boat through the churning rapids. Each boat usually held three men. Clad in life jackets made of cork and provided with kapok collars, the passengers resembled aviators fully equipped for a dash into freezing altitudes. They lay face downward in the boats, clinging tightly to the lifelines that were stretched across the decks.

During the entire journey the scientists of the party carried on surveying and explorative work. Of course, they did not make a chain survey of the river; but by a trigonometrical system well known to the surveying fraternity, they were able to



gage and map even the most furious stretches of the river.

Plane-table readings were taken along the banks at points from 500 feet to half a mile apart. Where the water rose straight and sheer, the surveyors had to exercise the sure-footedness and agility of mountain goats to make the readings.

One day the boats came upon a mammoth boulder, 80 by 40 feet in thickness, towering 30 feet above the waterline and exactly in the middle of the river. One of the boatmen, born and reared in Hawaii, upset the canoe. Though in the exciting water sports of his native land, he was not daunted by this mishap. Not only did he survive the fury of waters that would have overwhelmed the ordinary swimmer, but he also rescued the canoe. In the full course of the violent current, he righted the craft, boarded it and sped swiftly to the next camping place. A few days later this canoe was lost in an attempt to "line" it around Spring Cave Rapids; that is, to drag it around by means of lines attached to the bow and stern and handled from the overhanging cliffs.

### Boats Tossed High in the Air

The boatmen were constantly performing circus-like feats. Colonel Birdseye tells of one of these incidents. "In the Hammer Rapids one day," he says, "one of our boatmen was harried bodily from his craft when the backflow of high waves caught his boat and tossed it into the air like a ball bounding from a tennis racket. The boatman turned a complete somersault, then disappeared beneath the water. He was an expert swimmer though, and he pursued and captured his runaway craft, climbing aboard while the boat backed like a wild horse."

After heavy rains, the Colorado River sometimes rises very rapidly and without warning, as the water flows from the upper stream into the canyon.

"One night," says Colonel Birdseye, "we noticed that the water had begun to rise suddenly, endangering our boats, our provisions, and our lives, for we were in a



One of the majestic gorges of the Grand Canyon of the Colorado, where the sky appeared as a narrow slit between towering walls. Notice one of the surveyer's boats on the river, framed by the jagged cliffs. The picture at the left shows the surveyors skidding a boat over the rocks at the head of Soap Creek Rapids—a hazardous task.



narrow, boxlike canyon, with steep sides that afforded no foothold. With block and tackle we dragged the cook boat and provisions high up on the side of the cliff. With difficulty the other boats were run downstream to a place of safety. There the boatmen remained all night, every few hours dragging their boats still higher up the banks as the river rose.

"By the next morning the river had risen 16 feet, and it continued its upflow until it reached a peak point 21 feet above the

waterline. When we returned to civilization, we learned that the world had believed us lost during this flood, an opinion that seemed to have been confirmed by the fact that airplane searchers were unable to find trace of us."

At Separation Rapids at the mouth of a deep canyon, where three members of a former national expedition down the Colorado were killed by Indians, the waters have a fall of 20 feet. They must be dared in boats, since sheer walls make

it impossible to attempt a portage. One of the boats of the recent expedition was tossed high in the air in running these dangerous rapids. When it came down bottom uppermost, its three occupants were buried into the water.

The explorers managed to rescue their unfortunate companions, but not until one of them had been almost crushed to death against the rocks. During the whole trip only one man was severely injured.



# Listening In for Insect "Voices"

## *Supersensitive Microphone Designed to Perfect Radio Broadcasting Holds Fascinating Possibilities for Scientific Research*

By Donald Harris

**W**HEN you listen in on the radio to a violin selection or a piano solo, your ears and your memory tell you that what you hear does not sound exactly like the tones of any violin or piano you ever have heard. The sounds that come to you through your headset or loudspeaker approximate those of the instruments, but you would have little difficulty in distinguishing the sounds of a real violin or piano from the radio reproduction.

The scientific reason for this is that the microphones used in transmitting the radio programs are not sensitive enough to respond to the more rapid sound vibrations produced by the instruments and voices of the performers. The result is that over the radio you do not hear all the vibrations of most musical and voice tones, and consequently you do not hear their true tones. The same is true of a telephone. Familiar voices will sound strange to you because the telephone is incapable of transmitting the more rapid sound vibrations.

Recently, however, in the laboratory of the Westinghouse Electric and Manufacturing Company in Pittsburgh, Dr. Phillips Thomas perfected what he calls an "ultra-audible microphone," an instrument said to be capable of picking up sound waves of almost every conceivable rate of vibration, from the very lowest to those that are far too rapid to be detected by the human ear.

### *Perfect Radio Reproduction*

The prime purpose of this invention is to make possible perfect radio broadcasting to achieve perfect radio reproduction. This purpose, Westinghouse officials say, has been achieved—at any rate, from the broadcasting end. That is to say, broadcasting studios, using Doctor Thomas' invention, now can put perfect music in the air. To reproduce it, though, with equal excellence, naturally requires a receiver of equal sensitiveness. Such a receiver is not included in the equipment of the ordinary radio fan, but Westinghouse experts say it will be eventually.

In addition to its utility for radio, the fact that the new microphone seems capable of receiving sound vibrations within a range that may be limitless has led its inventor and other scientists to believe it may be used in the study of the sounds made by insects.

Scientists long have believed that insects make sounds which, because of their exceedingly high rate of vibration, are inaudible to the human ear. The reason why we cannot hear these sounds, if the insects make them, is not because they are not loud enough, but because the most

chance is decreased, the rate of vibration correspondingly decreases, causing lower tones. In each case, however, it is a record of the same singer's voice that is heard, and, if you are familiar with the voice, it is likely that you would recognize it whether played slowly or quickly.

So in the case of the modification of insect noises to make them audible. Though they would be reduced in pitch, the sounds heard would bear an exact relation to the original sounds.

Of course, scientists until now only have been able to speculate as to whether insects that do not make audible sounds actually make any sounds at all. Similarly, scientists do not know whether insect sounds, if they are made, represent a method of communication, or whether they are merely accidental and meaningless, like the sounds made by a man's arms brushing his sides as he walks.

The investigation of these mysteries of the insect world offers fascinating possibilities

from the standpoint of the scientist. That is why the new microphone has aroused much interest among entomologists.

The ability to hear hitherto inaudible insect sounds, though, does not necessarily mean that man ever will be able to read any meaning from such noises. In fact, scientists say such a possibility is most unlikely. In this connection they point out that we have been hearing the voices of birds, animals, and the larger insects for centuries, yet we are unable to interpret them beyond recognizing cries that betoken fear, anger, or pleasure.

### *How the Sounds Are Detected*

The ultra-audible microphone is a highly complex instrument and at present is virtually useless except in the hands of one who is expert in its operations. It consists of a ring of insulating material in which two small electrodes are inserted, exactly opposite each other and separated by only a few millimeters. Direct current of high voltage is applied to the electrodes, causing a "glow-discharge" in the gap. This is neither a spark nor an arc, but a streak of soft, purplish light.

As sound waves impinge upon this glow, it vibrates in sympathy and the flow of current to the electrodes varies correspondingly. The current variations cause the diaphragm in a pair of ear phones to vibrate, thereby reproducing the sound, just as vibrations of the diaphragm in an ordinary telephone receiver reproduce the sounds uttered in the transmitter.

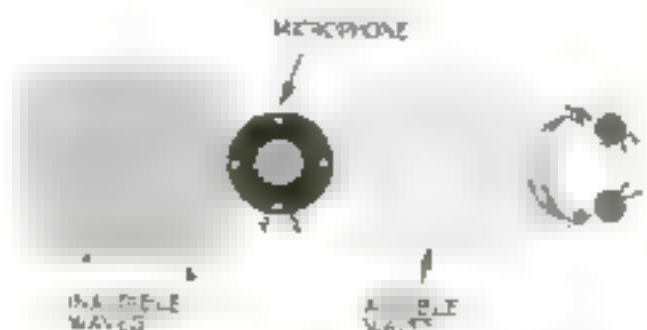


Listening in on a moth—Dr. Phillips Thomas using the ultra-audible microphone invented by him in an effort to perfect radio broadcasting and to determine whether insects "speak" in sounds the pitch of which is too high for human ears

sensitive ears are incapable of detecting sounds with a rate of vibration more than 20,000 a second. This, scientists believe, is many times less than the frequency of the insect sounds.

It has been suggested that insect sound vibrations might be picked up by the Thomas microphone, then transformed into light waves, which could be photographed for analysis as frequently is done in the laboratory. Of the sounds that are inaudible because of their rapid vibration could be transformed into sounds of proportionate vibration within the range of the human ear. This second method might be compared with the same modification of sounds heard when a phonograph record first is played rapidly, then slowly.

Playing a record rapidly increases the rate of vibration of the individual sounds, causing their pitch, or tone, to become higher. But when the speed of the ma-



This schematic diagram shows how the sensitive new microphone eventually may be used to translate high-frequency sound waves beyond the range of human ears into audible low-frequency waves of the same characteristics, thus detecting insect "voices" if they exist



# Emotions—the Fuel of Life

*Fourth Article in "The Story of the Mind"*

By James J. Walsh, M.D., Sc.D.

**I**N A small city of the Middle West that I have occasion to visit now and then are two drug-stores.

One of them has been established for many years. Its proprietor is an excellent pharmacist. That I know from experience. The other is a new store—about three years old. Its proprietor is not a pharmacist. Probably he could not compound a simple prescription if his life depended on it. The prescriptions that are brought to his store are filled by an assistant, a registered druggist.

And yet the newer store is the more successful, so much so that when I visited the city last, I was informed that the owner of the older store was on the verge of bankruptcy because his new competitor had made such heavy inroads into his trade. What was the reason?

The secret was this. The proprietor of the older store is a sour, silent man—a "grouch" to express it popularly—and his store is like himself—dingy, ill-lighted, and undecorated except by dingy shelves of chemicals. The owner of the new store, on the other hand, is affable, smiling, dapper; polite to his customers; ready, apparently, to go to any extreme to serve them. People who enter his store feel a warm glow of friendliness, in striking contrast with the depressing effect on them of visiting the other store.

A business expert, no doubt, would attribute the success of the new store to superior merchandising methods. To a psychologist, however, the explanation is immensely more simple. It rests on an elementary but highly important psychological principle—the power of emotion.

## What Emotion Is

An emotion is a state of mind that prompts to action. Love, hate, joy, sorrow, and anger are emotions. Hunger, thirst, pain, and similar bodily feelings are not emotions, although they may lead to emotions. Similarly, emotions are invariably accompanied by bodily feelings, and, unless repressed or hidden by action of the will, are displayed by such outward signs as blushing, trembling, weeping, laughing, and movement of the face muscles. The voice is generally affected, and frequently the mouth, eyes, and nose and the heart and other vital organs.

Professor William James, of Harvard, stressed the fact that a disembodied emotion is an impossibility. Yet emotions must be considered

apart from all bodily feelings or manifestations and must not be confused with ideas, for ideas merely find their way into the mind without prompting to action.

Thus, in the case of the two drug stores, the emotion of dislike inspired by the cheerless atmosphere of the older store led its former customers to take their trade to the newer store, where brightness, cheerfulness, and attractive decorations supplied the impetus that caused the brain and nervous system to react with the emotion of good feeling that makes spending easy.

## Why You Like and Dislike

Similar instances are everywhere about you. Meeting some people for the first time, you instantly like them. Other people you dislike even before you have spoken with them. Certain streets and certain cities have a depressing effect on you, while others inspire you. Your thoughts and feelings are quite different in a church during a funeral service and during an Easter service. In each case your emotions are being stirred.

One of the most successful lawyers I know bears the reputation of knowing very little law. Yet his ability to win apparently hopeless cases in jury trials is proverbial in the city where he practices.



© Irving Calloway

Anger rules momentarily by imparting fear. This picture shows Governor Peter Stuyvesant in an outburst of anger destroying the British summons to surrender New York in 1664.

He possesses a highly developed sense of dramatic effect, and in the cases he tries, he stakes everything on an appeal to the emotions of the jury. He realizes the important psychological principle that the emotions are a more potent moving force than reason or logic. They are elemental. They are ingrained in the very fibers of man.

"The emotions," states Dr. Carl George Lange, distinguished psychologist, of Copenhagen, "are not only the most important factors in the life of the individual, but they are also the most powerful forces of nature known to us."

## Man's Greatest Terror

No one who considers the vital influence of emotion even in every-day affairs will hesitate to subscribe to this opinion, for the emotions triumph over bodily feelings—hunger, cold, pain, fatigue, and illness; and a powerful emotion, such as love, can rise supreme even over man's greatest terror—the fear of death.

On love, an emotion of wide character that manifests itself in many diverse ways, is based the familiar rule, "women and children first," at times of disaster at sea. When the *Titanic* went down, men stood calmly by, knowing that they were inevitably doomed to death, to permit the women and children passengers to be saved. It was an emotion of chivalric regard for women, traceable



Courtesy Metropolitan Museum of Art

The most powerful of all human emotions—the love of a mother for her child—is portrayed in this fine painting, "The Vintage" by L. Bernier. Such an elemental emotion, says Doctor Walsh, is a more potent force than reason or logic, and can rise supreme over bodily feelings and over man's greatest terror—the fear of death.





Courtesy: Metropolitan Museum of Art

Fear the universal emotion is written on the faces of the wounded poacher and his son in Karl Wilhelm Hubner's painting, *The Poacher's Death*. Father and son, driven by terror of the approaching landowner and gamekeeper, are making a superhuman

effort to reach their cabin. The terrified son, his right arm supporting his father and his left extended to the door latch, is straining every muscle and nerve to drag his father to safety. The painting is a striking portrayal of the power of fear to drive the human body

probably to the age-old love of a son for his mother, that braced them for this. On the other hand, the love of some of the women for their husbands so strongly influenced them that they chose to perish rather than be saved without them.

Countless instances might be recounted of the emotion of love manifested as patriotism, or love of country, inspiring the most sublime heroism on the battlefield.

Beside the emotion of love may well be placed the emotion of hate. This is an emotion that has a very deep hold on humanity, proving at times a source of energy that enables people to make almost superhuman efforts. I have heard it said that a famous banker of other days owed all his success to his desire to be revenged upon another banker who affronted him early in his career. What degree of self-satisfaction his success brought him I have no way of knowing, for hate is by no means so lasting an emotion nor so strong an influence as love.

Still, it is remarkable that people frequently will be drawn together much more strongly by mutual dislikes, even in such trivial matters as dislike for certain foods, than by mutual likes.

This propensity of mankind was well expressed by the man who nominated Grover Cleveland as a candidate for President with the slogan, "We love him for the enemies he has made."

Success in life, especially in any active calling, almost invariably depends upon ability to stir the emotions of others while maintaining rigid self control. Executives control others more frequently through some degree of such emotions as love or fear than through reason.



Supreme courage is typified in Commodore Perry who, though forced to leave his shattered flagship, won the Battle of Lake Erie from the British. This painting is by W. H. Powell.

I know the head of a vast manufacturing enterprise whose knowledge of the technical processes of his factory is almost nil. Yet his organization is one of the strongest in the country. None of his employees or associates ever thinks of questioning his decisions or of opposing him, even though their knowledge of some details of the business may be greater than his. That is because he possesses the gift of stirring their emotions. They love him for his fairness and integrity, they respect him for his ability as an organizer, they find his enthusiasm contagious, and they give him their best work.

An opposite type is a man who operates a concern equally large. He has come up through the ranks and knows the details of his business far better than any of his employees. But he is inclined to be overbearing and even unfair with his subordinates. Yet his business is on a firm foundation, is eminently successful and his employees work with all their energy. This man rules through fear, one of the most potent of all emotions, yet one that has many unfortunate reactions.

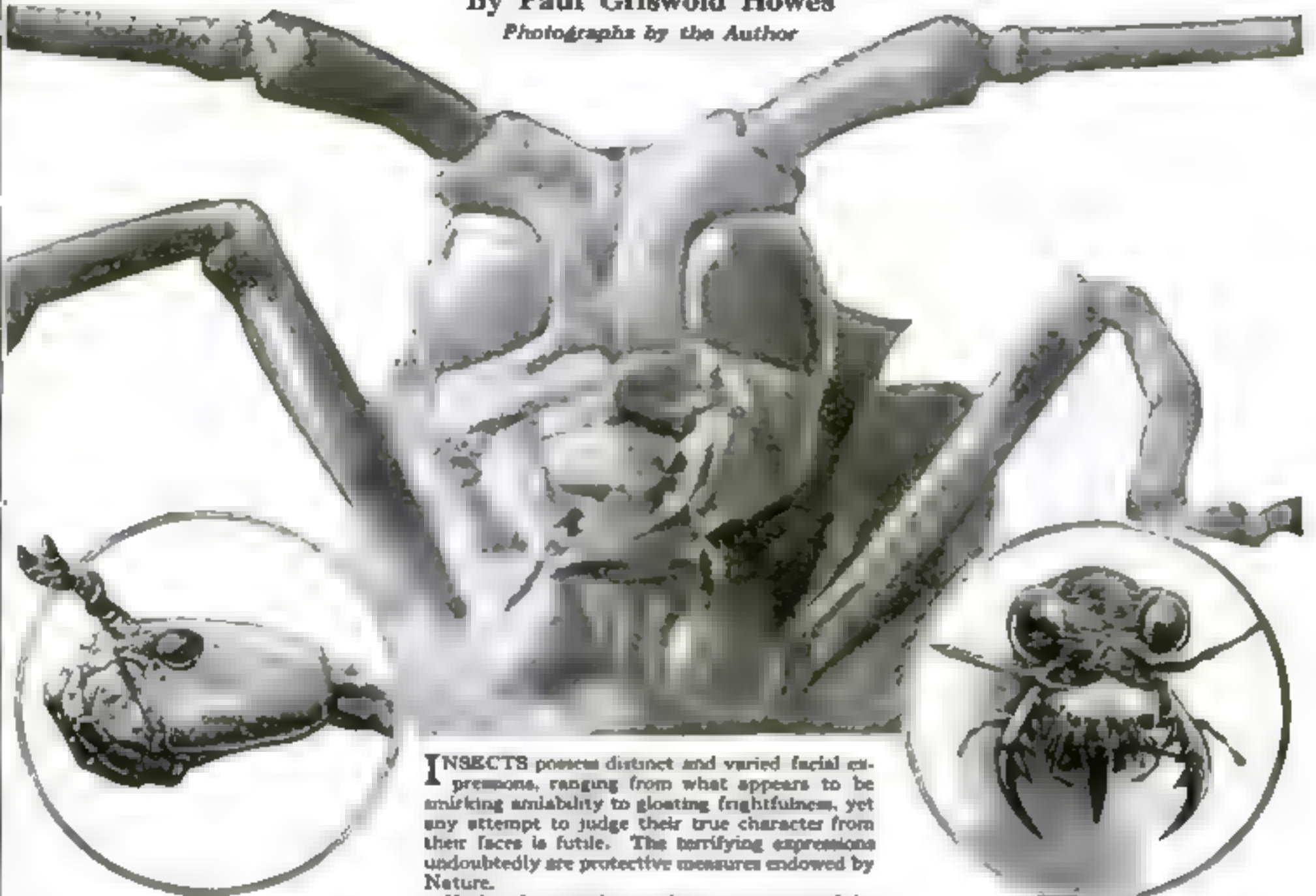
The old copy-book maxims that advised young business  
(Continued on page 131)



# Odd Faces from the Insect World

By Paul Griswold Howes

Photographs by the Author



**I**NSECTS possess distinct and varied facial expressions, ranging from what appears to be smirking amiability to gloating frightfulness, yet any attempt to judge their true character from their faces is futile. The terrifying expressions undoubtedly are protective measures endowed by Nature.

Notice the amusing studious expression of the Betocera beetle of Japan, shown above, with its wide forehead and huge goggles. Like most insects, this beetle has compound eyes with which it sees things in mosaic patterns.

The tiger beetle looks all that its name implies. Its mandibles resemble huge fangs, while its great wide eyes inspire terror.

The disposition of the bulldog-like Phyllium mantis of India fits its features. It is as ferocious and bloodthirsty as it looks.



Quite harmless, in spite of its threatening claws, is the great horned Hercules beetle of the West Indies shown below. Its lobster claws, intended only to frighten its enemies, cannot be opened. Its unusual size alone, as shown in comparison with the hand, would serve to keep most persons at a safe distance.



What appears to be the mouth of this grasshopper is formed by joints in its armor which, in overlapping, produce characteristic lines and indentations. The actual mouth is below the "chin." Nevertheless, the false mouth serves to give many grasshoppers distinct facial expression. The high forehead would classify this insect as a "highbrow."



The common dragon-fly or darnig-needle is all eyes and mouth. Its chin is decorated with a fringe of "Weary Willie" whiskers, and its face is everlastingly wreathed in a smile. Yet all this apparent good nature is false; for there probably is no more vicious destroyer of its fellow insects than this blood-thirsty bearded glutton.



# Summer to Winter in Forty Minutes

By Robert E. Martin

**W**HAT would you say of a summer vacation in which, after a morning of golf, tennis, swimming, or boating in the sweltering heat of July or August, you could spend the afternoon ice-skating, skiing, sleighing, or at some other winter sport in real winter weather?

Impossible? Not at all. Modern engineering skill has made it possible for you without effort other than that of donning suitable clothing. The recent completion of the first section of the world's highest aerial cable railway at Chamonix in the French Alps will enable tourists to take part in summer sports or winter sports as they wish during the summer at that famous resort and engineers of standing have declared that not less than a half-dozen snow-capped peaks in the United States might be converted just as readily into similar summer-winter paradises for sportsmen and vacationists.

## Enjoyed by Few

Winter sports in summer, of course, always were possible in the Alps. Few people, however, enjoyed them.

Similarly, in America, only a handful of venturesome tourists each year dare attempt an ascent of the mountains capped with ice and snow through all seasons. With a cableway, however, any one who desires may sit in a car and be carried to the snow country with no more inconvenience than would be experienced on a short railway journey.

The first wide use of the French cable road came during the recent competition in winter sports at the Olympic Games, when the cableway successfully carried spectators, competitors, and equipment to and from the field of sports.

Americans who witnessed the games were impressed by the possibility of building similar cable roads on several of the mountains in the western part of the United States, among them Mount Shasta, Calif., 14,380 feet high, at whose base is Shasta Springs, a well-known health resort; Gray's Peak, Colo., 14,341 feet, 20 miles from the city of Boulder; Pike's Peak, Colo., 14,110 feet, adjacent to Colorado Springs; Mount Rainier, Wash., 14,408 feet, near Seattle and Tacoma; Mount San Bernardino, Calif., 11,600 feet, 25 miles from San Bernardino and a little more than two hours' ride from Los Angeles; Mount Hood, Ore., 11,225 feet, near Portland. Other possibilities

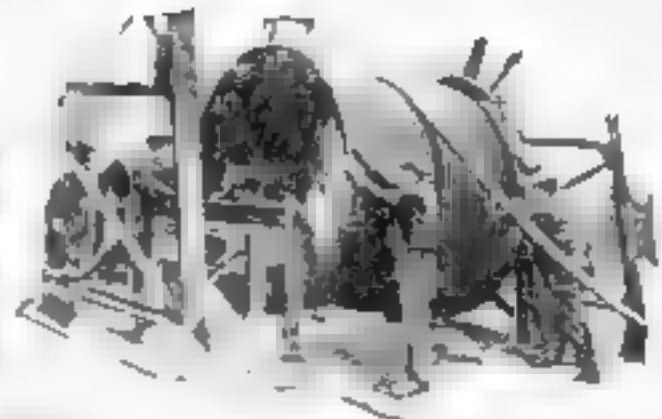
include Mount Whitney, Calif., 14,504 feet; Mount Harvard, Colo., 14,396 feet; and Pike's Peak, Colo., 14,335 feet. The cableway at Chamonix, which is now well on its way to completion, is 3½ miles long and will rise from a point 5,000 feet above sea level to the Aiguille du Midi, of 9,100 feet.



An aerial cable car of the Chamonix cableway carrying passengers from summer playgrounds to winter sports high in the French Alps

altitude, only 3,900 feet lower than Mont Blanc, three miles away. At some points the cars must ascend grades of 72 degrees. The construction was started in 1909, interrupted by the war, and resumed again in 1922. The entire line probably will be completed by 1926.

The project presents problems that challenge the ingenuity and skill of the engineers. To move materials up the mountain, for example, it was necessary to construct a temporary cableway on arches of wood. Wherever possible, paths were cut so that materials and machinery could be carried up by mules, but since a mule cannot turn on these pathways when laden with a burden more than 12 feet long, this method was necessarily limited. Some pieces weighing more than half a ton were fastened to cables and



One of the great problems used to construct a cableway with a highest altitude is that of Chamonix in the French Alps. The car is able to carry a load of 12 pounds a foot.

dragged up the mountain by a system of cables and pulleys.

A system of cables would carry the cable over their shoulders, while another would aid them by pulling at the end of the cable which was run through

the mountain. It required 10 days to move a cable over less than 150 feet by this method over a wintered ground.

## A Staggering Task

The transportation of the cables likewise was a staggering task. The largest cable of the system weighs about 12 pounds a foot and a run of about 400 feet with its special carrier make a weight of 24 tons. Trucks were constructed of special steel to transport the cables up the steepest slopes to facilitate the hauling of the cable. To transport the trucks were placed on a special track of steel rails and rollers.

Steel towers to support the cables, these vary in height from 39 to more than 100 feet, exclusive of their foundations, according to the profile of the slopes. The towers are protected against avalanches by immense ramparts.

Two cars, each containing seats for 18 passengers, are run on the new section of railway. One car ascends while the other descends. They are suspended from the carrier cables a little more than 12 feet apart, and travel at a speed of about five miles an hour. At this speed the 3½-mile trip from summer to winter can be made in about 40 minutes.

Each car, of course, travels on its own rail and has a separate guide cable, which runs through a ring in the carriage and prevents the car from swaying in the wind. Two other cables—a tractor cable and a brake cable—are used by both cars. The tractor cable is endless, and is operated at the upper station by pulleys and a





**T**he first of these is the fact that the system is not a simple one. It is a complex system, and the complexity is not only in the number of components, but also in the way they are interconnected. The second is the fact that the system is not a static one. It is a dynamic system, and the dynamics are not only in the way the components interact, but also in the way the system evolves over time. The third is the fact that the system is not a linear one. It is a non-linear system, and the non-linearity is not only in the way the components interact, but also in the way the system evolves over time. The fourth is the fact that the system is not a deterministic one. It is a stochastic system, and the stochasticity is not only in the way the components interact, but also in the way the system evolves over time. The fifth is the fact that the system is not a simple one. It is a complex system, and the complexity is not only in the number of components, but also in the way they are interconnected. The sixth is the fact that the system is not a static one. It is a dynamic system, and the dynamics are not only in the way the components interact, but also in the way the system evolves over time. The seventh is the fact that the system is not a linear one. It is a non-linear system, and the non-linearity is not only in the way the components interact, but also in the way the system evolves over time. The eighth is the fact that the system is not a deterministic one. It is a stochastic system, and the stochasticity is not only in the way the components interact, but also in the way the system evolves over time.

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# Black Flour—The New Fuel

*Pulverized Coal Piped into Furnaces like Gas*

By Truman Stevens

**P**IPING coal from the mine directly into industrial furnaces, as electric power and gas now are delivered from a central station to consumers, may seem like a wild flight of fancy; yet that is what fuel experts say may be seen in the future as a result of recent developments in the use of pulverized coal—the world's newest fuel.

## Great Fuel Saving

Conservation of America's coal resources, estimated by John Hays Hammond at 4000 billion tons; increased power efficiency for each ton consumed and therefore greater industrial economy; elimination of the smoke nuisance in industrial centers—these are other important benefits which the new fuel is expected to bring.

Of these possibilities, conservation and economy are of vital interest to the consumer. It has been estimated that one third of the nation's high-grade coal already has been mined. We now are consuming about six tons per capita annually, as compared with the 3.6 tons burned for each inhabitant in 1900. At present the industries of the country, including railroads, are taking nine tenths of the best grade coal from the mines.

## May Reduce Coal Prices

If industry in general, by utilizing the highly inflammable pulverized "black flour," can consume the poorer grades of coal represented in the culm piles—those mountains of discarded coal dust, screenings, and slag familiar to every mine



Coal screenings, of little commercial value heretofore, are declared to be ideal for making the new pulverized fuel. Above are shown great piles of screenings for use in firing cement kilns.

experts believe that the domestic grades will become more plentiful and consequently less costly.

Already the new fuel is being used in two important branches of industry—in the firing of rotary cement kilns, and in electric-light and power plants where the constant rate of heat produced by the pulverized fuel is said to be a decided

A few weeks ago engineers at Fullerton, Pa., succeeded in pumping coal that had been ground fine as flour far more than a

mile through a five-inch pipe line. The tests were made on a system actuated by a revolving screw pump that starts the coal mass in motion. At the discharge of the pump, the mass is rendered semi-fluid by aeration with a number of small streams of compressed air. These streams carry the coal along, largely in suspension, to the point of discharge of the pipe line. Thus the area over which coal powdered at a central plant may be used is greatly extended. Central pulverizing plants supplying a number of boiler plants become a practical possibility, without the necessity of cars for moving the coal from pulverizer to boiler plant.

## Burns like Gas Flame

Powdered coal, ground so fine as to pass through a sieve that will hold water, burns as it flows into a furnace, like the ignition of the flow from a household gas jet. Also, as with a gas jet, the quantity burning may be controlled and any desired heat may be maintained. It produces so

much heat, engineers say, that it will greatly increase a boiler's efficiency. This naturally results in greater economy.

Dr. Alexander G. Christie, professor of mechanical engineering at Johns Hopkins University, is authority for the statement that the efficiency of a ton of powdered coal is between 85 and 92 per cent. From 50 to 60 per cent efficiency is considered high for ordinary lump coal as it is burned in some hand-fired boilers, and 76 per cent is high for even the best mechanical stokers.

Doctor Christie estimates that it costs about 30 cents a ton to pulverize bituminous coal and 50 cents to pulverize the hard or anthracite coal.



Piping pulverized coal into a cement kiln. From a feed bin the fuel is carried by screw conveyor into an injector where it is blown by compressed air into the kiln and then fired.



The coal is powdered so fine that it will shake its way through a 20 mesh sieve with 40,000 perforations in the square inch. This gives it a fluid water as pictured below.



Shooting with the velocity of a hurricane into the cement kiln, the pulverized coal burns in a great tongue of flame 20 feet long. The injector pipe is seen above the man's head.



# Science Sees, Hears, Counts Atoms

## *New Triumphs in Spectacular Conquest of Tiny Worlds of Wealth*

By Raymond J. Brown

FROM Paris recently came word that Madame Curie, famous as the discoverer of radium, had invented a machine more startling and far more dramatic possibilities than even the telescope that gave to man his first real understanding of the sublime wonders of the heavens.

This machine enables scientists to hear and count atoms. More than that, it makes it possible to amplify the sounds so that through a radio loud-speaker they may be heard by the audience in a theater or lecture hall. The sounds are ticks produced as helium atoms are discharged from polonium, the daughter element of radium.

### *Seeing the "Invisible"*

A machine more amazing than that, the human mind is incapable of imagining. It may be said to achieve the impossible, for it makes audible and all but tangible the movements of infinitesimal particles of matter that are invisible, and, according to scientists, always must remain invisible to the most powerful microscope that ever can be constructed. For an atom in size is to the smallest thing visible under the microscope as the smallest microscopic body is to our world.

And yet scientists, by other means than microscopes, actually have seen atoms; they have measured them and photographed them, and now they can hear them. Through their studies of atoms they have formulated one of the most startling and important scientific theories of history. They have come to the belief that all creation—the earth on which we live, the air we breathe, the other worlds that whirl through the boundless depths of space, even we ourselves and every conceivable particle of matter that may exist—is electricity; that there is no other substance in the universe.

And in this new theory regarding the composition of the universe, they see possibilities that may revolutionize completely present-day scientific methods, especially in chemistry and physics, and that may point the way toward boons for humanity that all but challenge credence.

### *Hidden Sources of Wealth*

The transmutation of matter—the change, for example, of lead into gold, or of other materials that are on the earth in plenty into materials that are rarer and more useful, sources of light and heat that will make man independent of the exhaustion of the

world. It is a machine that will enable us to see and hear and count atoms. It is a machine that will enable us to see and hear and count atoms. It is a machine that will enable us to see and hear and count atoms.

and are what are known as compound substances. They are—like most of the substances we see around us—formed through combinations of other substances that the chemists call "elements."

Oxygen and hydrogen are elements. So are gold, iron, copper, and other metals. So are helium, the gas now used to inflate airships, and radium, the rarest and most expensive substance known.

### *What Elements Are*

Science says there are 82 elements, 87 of which are known. They are called elements because they have resisted all attempts to decompose them into simpler forms of matter. Oxygen, for example, remains oxygen, no matter what you do to it. You can combine it with some other element, as with hydrogen to form water, but you cannot split it up into any other substance. Its smallest particle remains oxygen.

This property of elements of retaining their individual characteristics is what caused chemists of modern times to laugh at the efforts of the alchemists of old to change one element into another, particularly to form gold

from the baser metals. Similarly, as one element after another was discovered, modern chemists laughed at the ancients who thought that all matter was composed of four elements—earth, air, fire, and water.

### *A Marvelous New Alchemy*

But in the light of the wonderful new facts regarding the structure of matter disclosed to us as a result of science's invasion of the realm of atoms, the reason for laughing at the pioneers of science seems not so evident. For the possibility of the transmutation of matter has been demonstrated so conclusively by those who have penetrated the fascinating miniature worlds of atoms that every scientist of standing in the world has accepted it! It was only recently that the American Society for the Advancement of Science, in convention at Cincinnati, went on record as approving the new theory. Moreover, now that science is demonstrating the theory that everything in the universe is essentially electricity, the ancient theory of a four-element world seems not quite so ridiculous.

But how does this new theory work out? If oxygen thus far has resisted successfully all attempts to make anything but oxygen out of it, and iron has remained iron, who dares say that they both are composed of electricity?

Dr. Niels Bohr, who is professor of



The latest portrait of Madame Curie, famous discoverer of radium, seated in her laboratory in Paris, France, where she recently invented a marvelous little machine that enables scientists to hear and count atoms. Standing beside her is her daughter Irene, who is her assistant.

once of the word "atom" when you wished to convey the idea of anything exceedingly small. You have spoken, for example, of a thing being "blown to atoms." Chemists, though, long ago applied to the word a more restricted meaning. To them an atom was the smallest particle into which a substance could be divided. Possibly it would be better to say the smallest particle of a substance that could be imagined, for the "division" of which the old chemists spoke was entirely theoretical. Nobody hoped to isolate atoms and study their structure.

Now, to all chemists, an atom does not mean the smallest possible particle of any substance. There is no such thing, for example, as an atom of water, an atom of wood, or an atom of air. Water, wood,



This wonderful machine, invented by Madame Curie, makes it possible for an audience to hear helium atoms as they are discharged from polonium, the daughter element of radium. Ticks produced as each successive atom is discharged are made audible with the aid of a loudspeaker. By these sounds the atoms can be counted.



mathematical physics at the University of Copenhagen, dare to say so for one. And, because he said so—and proved it to the satisfaction of some of the world's foremost scientists—he was awarded the Nobel Prize for physics and has been hailed as one of the great pathfinders of science.

Sir Ernest Rutherford, president of the British Society for the Advancement of Science, is another who says so—and offers proof of it. Sir J. J. Thomson, noted British scientist, is another. Sir Oliver Lodge, too. The list might be multiplied until it contained the names of every chemist and physicist of renown.

The methods of those who evolved the theory are beyond the comprehension of any but the most learned scientists, but their results are understandable—more, they are filled with thrill and romance, they spur the imagination; they appeal, because they seem boded directly for vast fields of usefulness. This, briefly, is what they say:

### The Electrons

The atoms of all substances are composed of a nucleus—a positive charge of electricity—about which from one to 92 electrons—negative charges of electricity—whirl in definite orbits, exactly as the earth and the other planets revolve about the sun.

The electrons travel at a speed that varies—according to their distance from the nucleus—between 2000 and 93,000 miles a second, which means that the number of revolutions an electron will make in a second cannot be recorded in less than 15 figures. In other words, all about us as well as in our own bodies are millions and millions of tiny worlds, each so small that it compares in size with a pinhead as a pinhead compares in size with our world.

The nuclei are the "suns," the electrons the "planets." The electrons in each atom are relatively as far away from their "sun" as we are from ours, and the mass of the nucleus is about 18,000 times that of each electron. Also, as in our solar system, these incredibly small planets—some moving with half the speed of light—travel truly in their courses, responsive in a measure to the law of gravity, for they attract and repel each other as do the greater bodies in our universe.

And, since the electrons are relatively far from the nuclei, the structure of atoms is open, even empty; so much so that, even in substances like iron, which to us seems like a solid mass, the volume of

solid matter in the atoms compared with the whole would be represented by this proportion: 1 to 1,000,000,000,000,000.

The same thing may be expressed in this way: If an atom were a circular field three miles in circumference, the nucleus would be as large as a locomotive's driving wheel and each electron the size of a pea.

Doctor Bohr has said that it would require a million times a million times a million hydrogen atoms to equal in size the smallest speck that could be weighed in a chemical balance. Dr. Paul Foote, of the United States Bureau of Standards, at a time when a trillion German marks were worth 60 cents, asserted that one

another—their weight, their color, whether they are solid, gaseous, or liquid and so on—according to the number of electrons that revolve about their positive nuclei.

Thus, if you take for a nucleus a single positive charge—or proton, as it is sometimes called—and set a single electron spinning about it, you have an atom of hydrogen, for hydrogen has an atomic solar system consisting of only one "sun" and one "planet." If you can manage to persuade 31 additional electrons to enter this miniature solar system, and introduce a positive charge of equal value into your nucleus, your atom of hydrogen—which, by the way, is the lightest known substance—becomes an atom of copper.

If you could draw out 26 of the electrons that you let into your solar system and leave enough positive electricity in the nucleus to neutralize the remainder, your atom of copper would become straightway an atom of carbon.

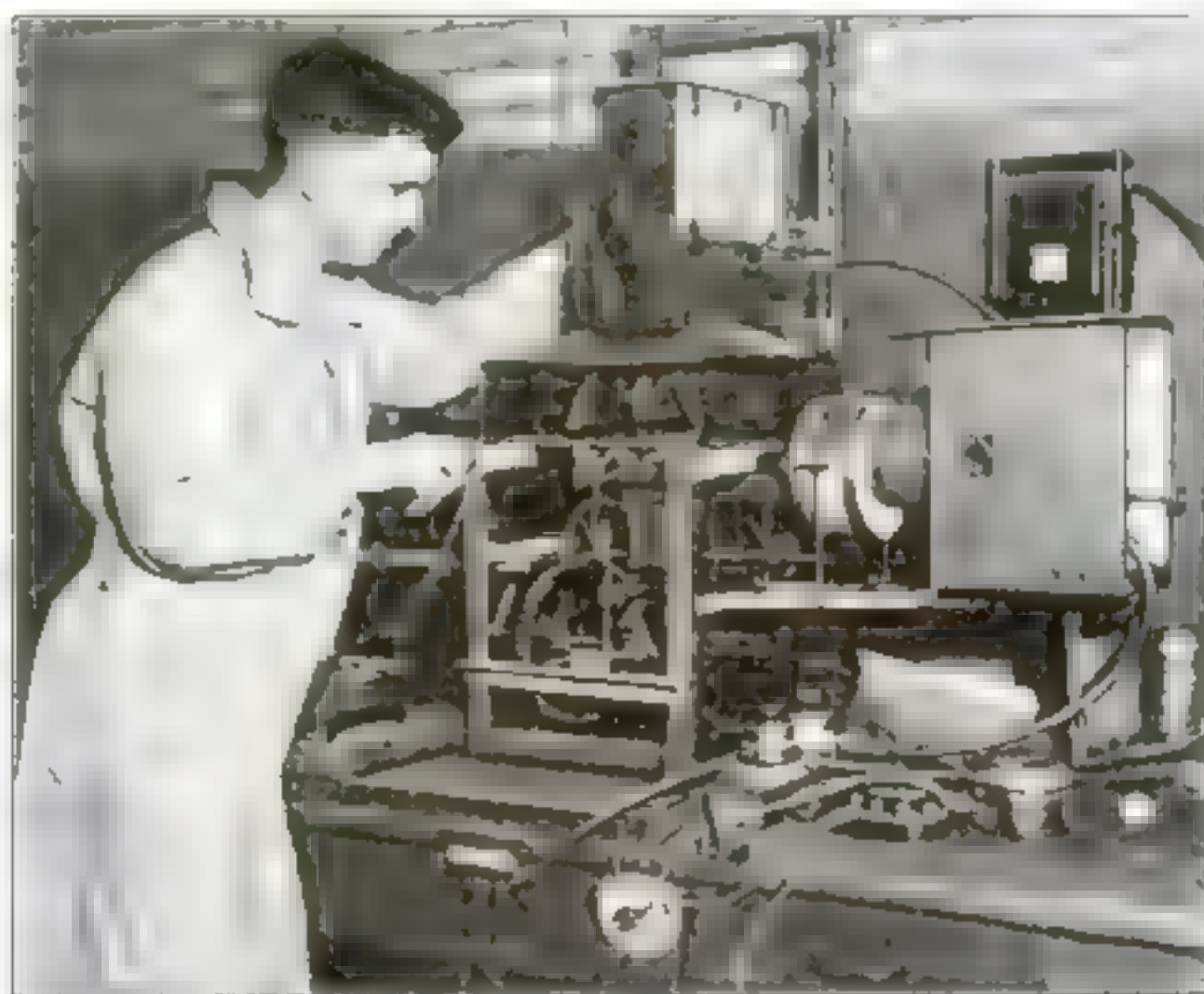
### Changing Atoms

It might occur to you here that you'd like to have an atom of uranium, which is the heaviest known substance. To do this, all that is necessary is to add 86 electrons to the six that are whirling about in your carbon atom and increase your positive charge correspondingly.

There is an even more dramatic transformation

that is theoretically possible and that should be even easier than any of those suggested. An atom of mercury consists of a nucleus with 80 electrons as satellites. If in some way you could dislodge only one of those electrons and maintain the proper balance in the nucleus, you would have an atom of gold, for gold is the substance next to mercury in the atomic scale, its atoms consisting of a nucleus and 79 electrons.

Attempts to effect this transformation, or transmutation, for it would be exactly that, actually have been attempted by scientists of the United States Bureau of Standards in Washington. They have hurled heavy charges of electricity into tubes containing vaporized mercury, the idea being that the onrush of free electrons—for this is what modern science believes the flow of electric current to be—might dislodge the necessary electrons and protons from the atoms of mercury and thereby change the mercury into gold. The world's supply of gold has not yet been increased by this method, but the actual accomplishment, scientists assert, awaits only the development of apparatus capable of maintaining a 1,000,000-volt current.



Although atoms are so small as to be far beyond the range of the most powerful microscope science has succeeded in photographing collisions between them, as well as the comet-

like paths of their flight. This has been accomplished at the University of Chicago by the sensitive apparatus shown above timed to a conventional motion-picture camera.

mark would buy 3,000,000,000 atoms of gold.

A bucketful of water contains so many atoms of hydrogen and oxygen that if each, by some magic alchemy, were transformed into a grain of cement, you'd have sufficient material to construct a motor highway a mile wide and three feet thick, that would circle the United States.

### Why Substances Are Different

If you can think in terms like these, you can form in your mind a definite picture of the structure and size of an atom. But how is it, you may ask, if all atoms consist merely of electricity—a positive nucleus surrounded by a whirling group of negative electrons—that we have 92 widely different elements, ranging from light gases like hydrogen and helium to heavy metals like lead and platinum?

According to the theory first advanced by H. G. J. Moseley, a young British scientist killed in the war, and later developed by Doctor Bohr and others, the explanation of that apparent anomaly is quite simple. Substances acquire the properties that make them differ from one



# ATOMS OF HELIUM

Helium atoms, each of which is made of two protons and two neutrons, are shown in the upper left corner of the photograph. The atoms are arranged in a regular, repeating pattern, illustrating the crystalline structure of helium.

The atoms are arranged in a regular, repeating pattern, illustrating the crystalline structure of helium.

An interesting feature of the photograph is the regular, repeating pattern of the atoms, which illustrates the crystalline structure of helium.

## SECTION OF SPINTHARISCOPE SHOWING PARTICLES BEING EXPELLED

Even before science knew as much as it now knows about the composition of atoms, the little planets that whirl about in the atomic worlds were being put to work for the benefit of mankind. What

was the attempt to turn mercury into gold by electronic bombardment but the thing that has been done for years in the mercury vapor lamps found in every commercial photographer's establishment,

in every moving picture studio, in thousands of shops and factories?

The vacuum tubes that are the detectors and amplifiers of your radio set, the

(Continued on page 133)



# In the Mirror of Science

## New Discoveries and What They Promise for You

### The Conquest of Disease

**W**ILL man ever be in complete control of the diseases to which he is now subject? Will the time ever come when the only causes of death will be old age and violence?

Announcement of amazing advances in medical science have been made during the last few weeks. Dr. A. R. Dochez, of Columbia, reports the discovery of a serum for scarlet fever, a disease of childhood that has puzzled physicians for more than half a century, while from Chicago comes word that Drs. George F. Dick and Gladys Henry Dick have devised a test to determine human susceptibility to this disease. The test is expected to do for scarlet fever what the Schick test does for diphtheria.

A preventive serum for measles is another discovery, made by Drs. George H. Weaver and T. T. Crooks at the John McCormick Institute for Infectious Diseases at Chicago. And Doctor Manuclins, of the Pasteur Institute, Paris, has isolated the microbe of rabies, which even Pasteur, discoverer of the anti-rabies serum, sought vainly to do.

Cancer, too, eventually must yield to the advance of science. On the next page is pictured a giant X-ray tube developed by an American scientist, which has put a new and powerful weapon into the hands of physicians who are fighting this terrible disease. Meanwhile two Parisian physicians, Drs. A. Kotzareff and L. Weyl, by adding radio emanations to a blood serum, have been able to obtain photographs of cancers inside the body, a method hailed as giving promise of far-reaching effects in the detection and treatment of the disease.

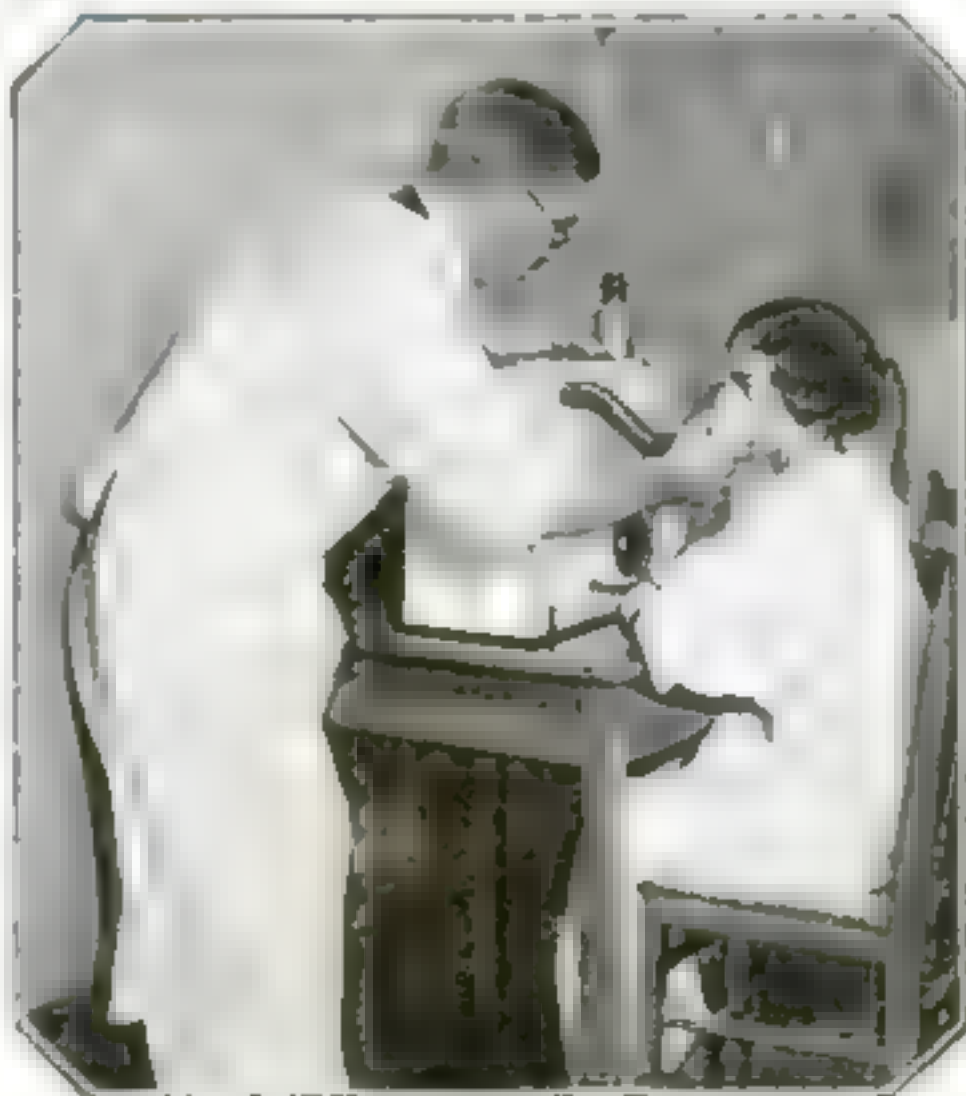
### A New Universe Discovered

**L**IGHT travels at the rate of 186,000 miles a second. How far away from the earth, then, is an object whose light takes a million years to reach here? The distance is six billion billion miles—six followed by eighteen ciphers—according to astronomers of the Harvard Observatory who recently photographed a new universe that far away from us. So far as is known this is the most distant object that man ever has seen, although that does not mean there are not other worlds fifty, a hundred or even a million times as far away.

Even to large telescopes the new universe is merely a faint luminous blur, but the pictures made of it by the 100-inch reflecting telescope at Mount Wilson, Calif., the largest in the world, made possible the identification of this hazy pin-

point of light as a universe like ours, although apparently much smaller. Astronomers know our newly identified neighbor of the sky only as "N. G. C. 6822."

Perhaps the inhabitants of other worlds in the depths of space call our solar system by some equally casual title and wonder if its planets are inhabited.



In a new treatment for pulmonary tuberculosis announced by Dr. Thomas F. Nolan, of New York City, the patient inhales uncrystallized carbon and calcium salts, which are said to build up the fibrous tissues of the lungs, arresting the progress of the disease. Doctor Nolan is shown above demonstrating the use of his inhaler.

### A Successor to Moth Balls

**W**OOLEN clothing and furs now may be protected absolutely against moths, it is said, by impregnating them with a new chemical called "Eulan F," developed in Germany after more than a half century of experiment. The substance is non-poisonous to human beings and harmless to the garments, but is said to cause instant death to the larvae of moths.

Almost 60 years ago German dyers noted that goods dyed green was safe from moths, and it was found that this was due to a certain pigment used in green dye. Since then chemists had sought a moth-proofing substance that could be used on clothing of any color, but only recently were they successful.

"Eulan F" is used in wool or furs in manufacture; then it is sprayed on at infrequent intervals during the life of the garments. Some time this process will come into general use. Then you can put your furs away for the summer without the conventional camphor balls and feel no uneasiness about its safety.

### Locating Ore by Quakes

**S**CIENTISTS in Switzerland recently devised an ingenious, and, it is said, virtually infallible method of prospecting for ore. They use imitation earthquakes; that is, ground tremors produced by violent explosions.

Observers of earthquakes have known that the wave forms traced by seismographs during a quake give definite information regarding the rock formations in the area of the disturbance. Hence, reasoned the Swiss scientists, if a violent explosion is produced in the center of a section where ore has been found, seismographs placed at various points will record graphically how far and in what directions the ore-bearing rock extends, thus making unnecessary experimental sinking of shafts and other cumbersome methods of prospecting.

### Mice and Men

**P**ROFESSOR Ivan P. Pawlow, Russian physiologist, has taught white mice to answer the dinner bell. In doing so, he found that although the first generation required 800 lessons to learn that the bell meant feeding time, the second generation needed only 30 lessons, and the fifth generation only five. In time, the professor says, he expects newborn mice to know what the ringing of a bell means without instruction.

These experiments have convinced him that acquired abilities are a matter of physiology and not of psychology, and that they may be inherited. If his theory stands the test of more exhaustive experiment, it will mean that you can assure your son of success by passing along to him an aptitude for acquiring your hard-won abilities.

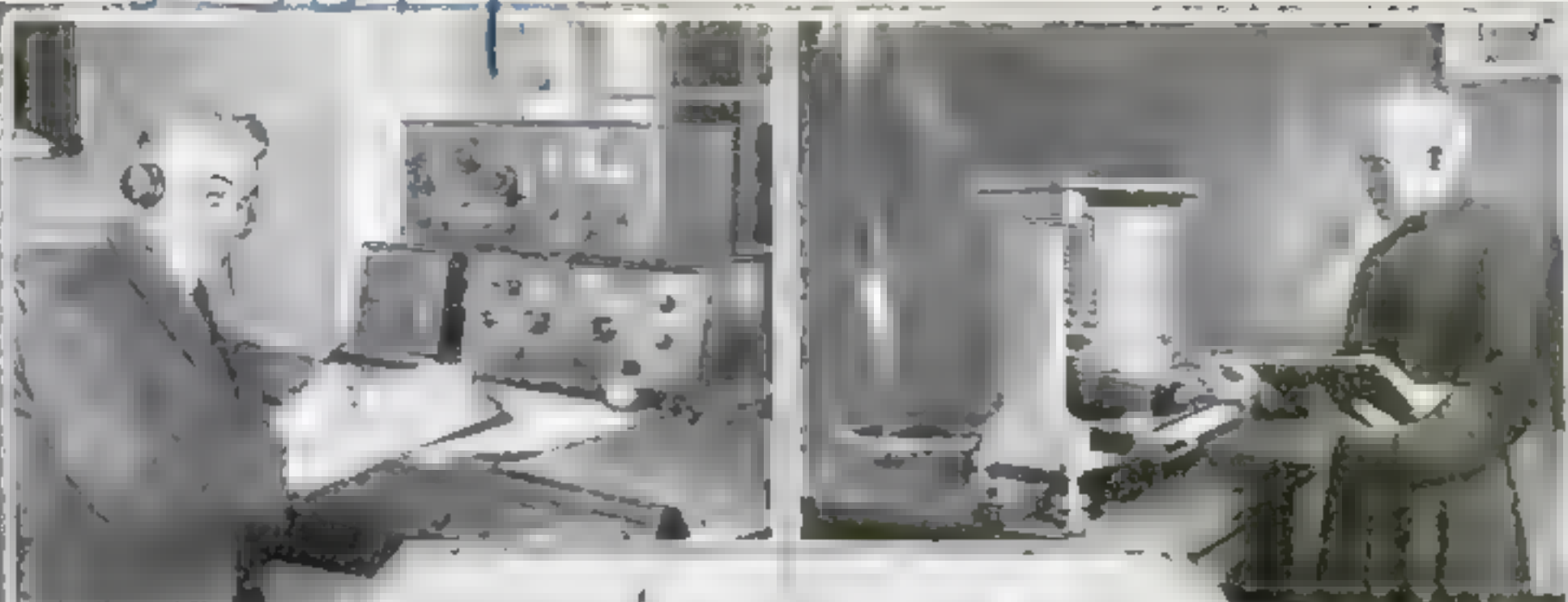
### A Boy or a Girl—Which?

**W**HETHER it is to be a boy or a girl has ever been a profound mystery. Now, though, Dr. Isaac Fried, of Czechoslovakia, declares that by a blood test he can ascertain the sex of a child four months before birth, a discovery bound to lead to important advances in eugenics.

### More Triumphs for Radio

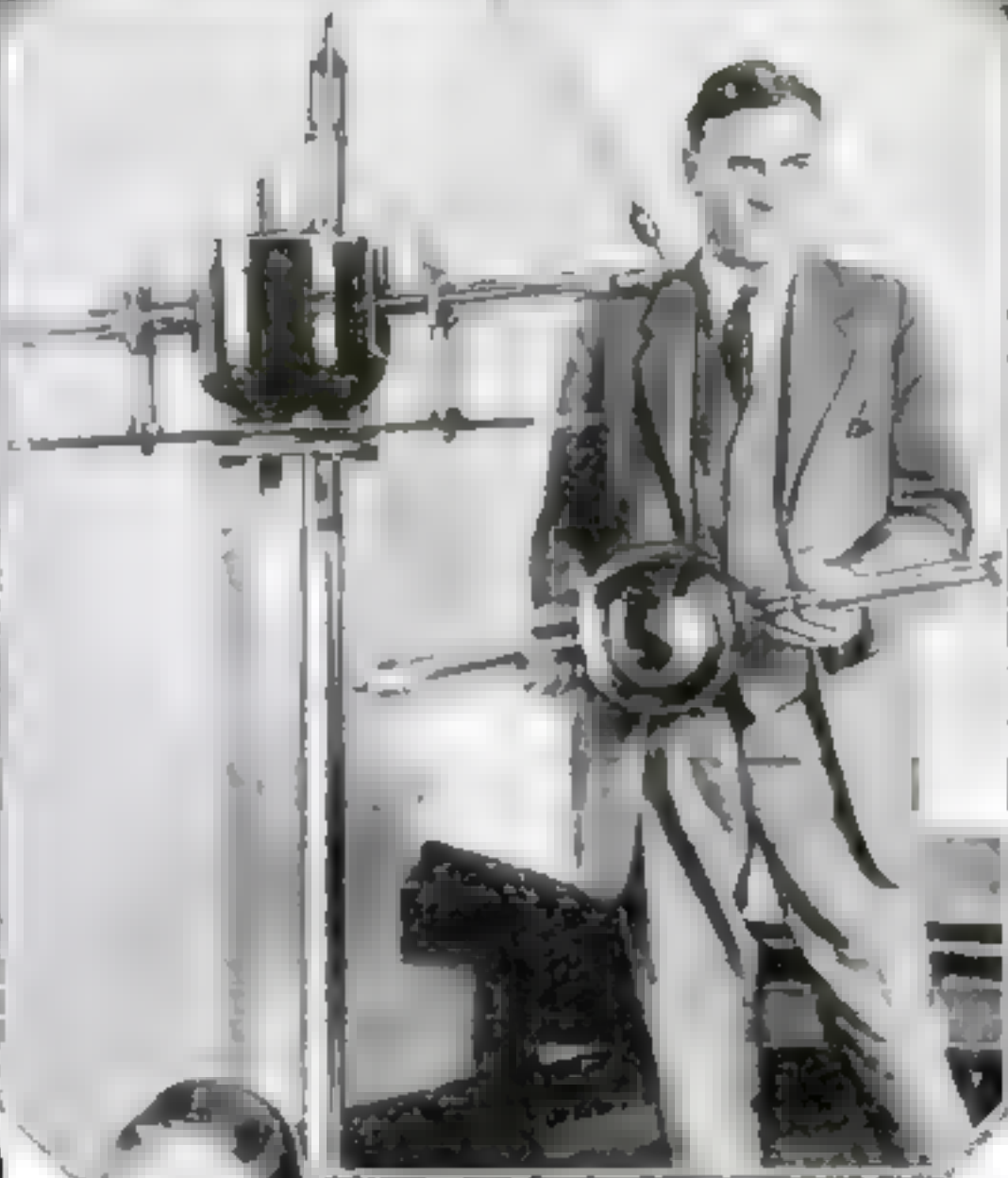
**R**ADIO waves apparently recognize no barriers. A broadcast concert has been heard in a tunnel under the Hudson River. Wireless code signals have been picked up 1400 feet underground in an Arizona mine. The present generation may yet see radio superseding the telephone, telegraph, and cable.





The first American to catch the "Hello, America" broadcast from England a few weeks ago was Hiram Percy Maxim, president of the American Radio Relay League. He is shown above with his double receiving radio apparatus.

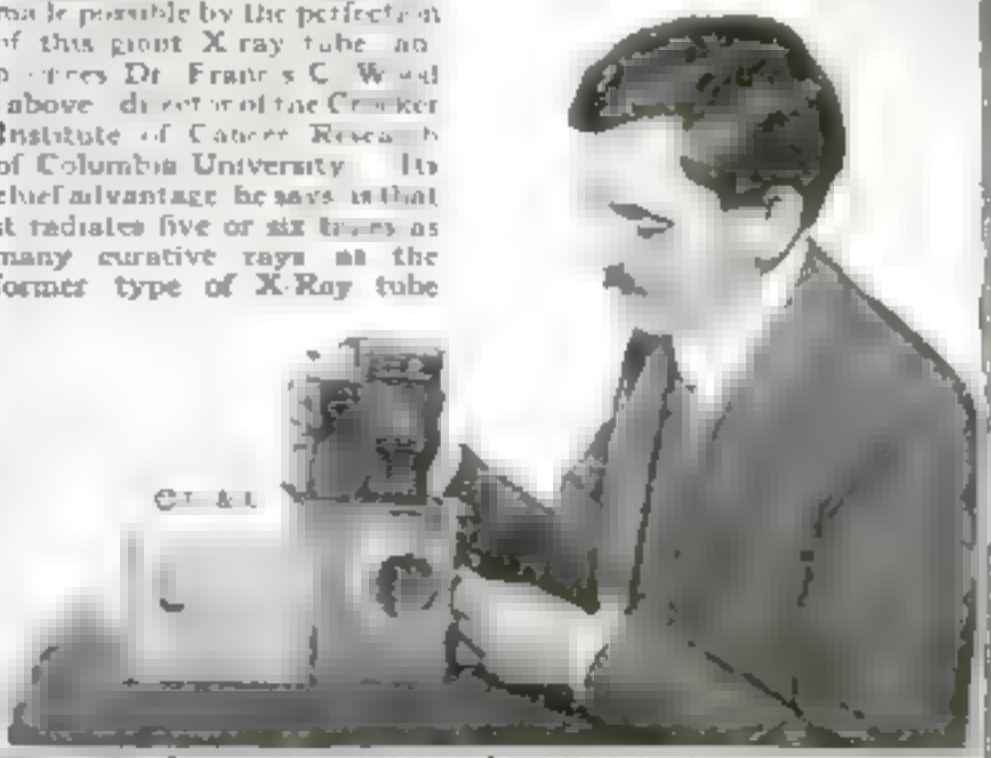
That metals, like men, "get tired" and break down, often causing accidents, has been revealed in investigations by the Physics Department of the University of Illinois. Below Prof. H. F. Moore and Prof. T. M. Jasper of the department are seen inspecting a piece of metal that resisted more than a billion stresses before it broke down.



An unusual instrument that measures velocity of the wind by sound has been invented by Abbé Rousselot, a venerable teacher of science in the College of France. As the wind drives the reeds, it produces sounds of varying pitch. Measure of the number of vibrations determines the wind velocity.

Photographing wonders of the deep sea has been simplified by Dr. Paul Bertolotti of the Division of Alaska, National Museum, Washington, D. C., who has invented a pocket size movie camera that can be operated efficiently under water. The camera is inserted in a watertight copper box fitted with a lens and finder.

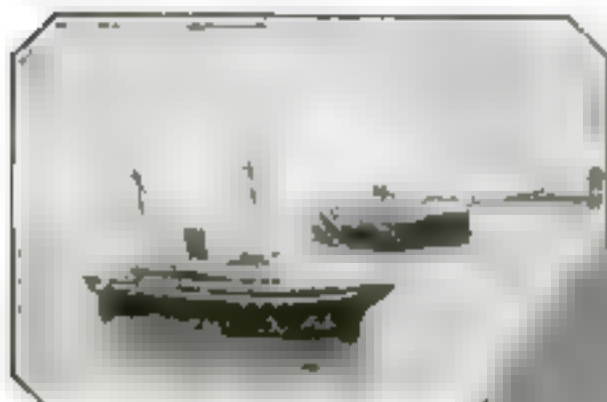
A distinct advance in the X-ray treatment of cancer has been made possible by the perfection of this giant X-ray tube, and pictures Dr. Francis C. Wood above, director of the Crocker Institute of Cancer Research of Columbia University. Its chief advantage, he says, is that it radiates five or six times as many curative rays as the former type of X-ray tube.





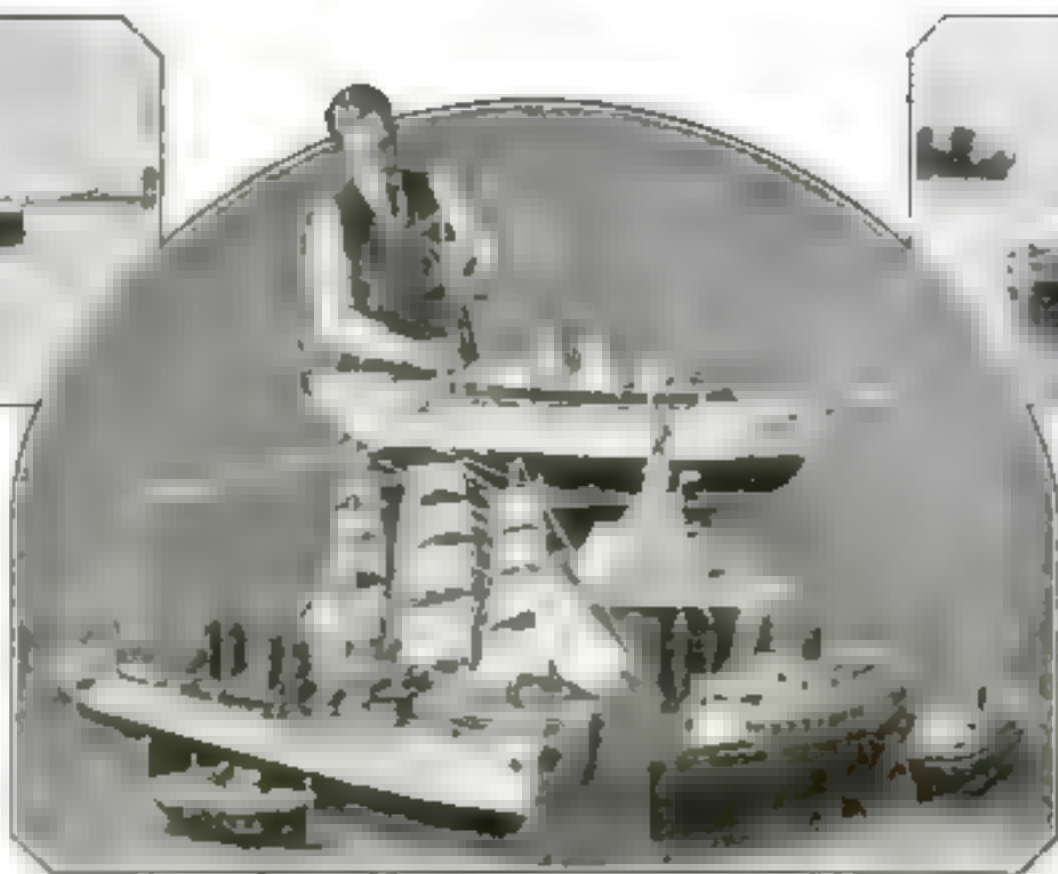
# "Why I Value My Hobby"

*Prize Contest Winners Find Happiness in Useful Relaxation*

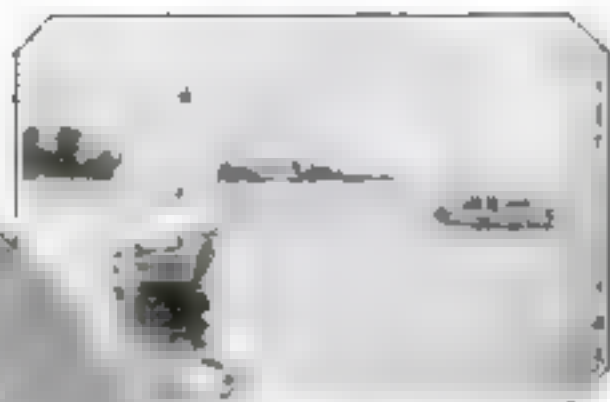


Model yacht and steamship sailing on Saginaw Bay

POPULAR SCIENCE MONTHLY'S Hobby Contest brought excellent photographs and letters from our readers telling how they found health, happiness, and success in diverting occupations. From these the judges have selected the following



F. G. Griffin of Saginaw, Mich., with his sheet-metal ship models



Model sailing ship and deck over, built as a hobby

**By F. G. Griffin, Saginaw, Mich.**  
*First prize, \$20*

A FEW years ago, if some one had asked me whether I had a hobby, I should have been at a loss for an answer. I did not start out to develop a hobby. It just came about in a natural way.

I am in the sheet-metal business, and often had thought I should like to make something out of the ordinary—something that would tax my ability as a sheet-metal worker to the limit. Anything in the form of a model always has drawn my attention, so I decided to make a model ship.

My first work was a model of the *Mad Cross* ship *Irene*, 84 inches long and made entirely of sheet metal. I became so interested in this work that I could not stop, and so I made several other ship models.

The work calls for a great deal of pattern drafting, designing, careful study of proportion, as well as resourcefulness in finding materials with which to fit out the different boats. The painting of the models, too, calls for much research. I greatly enjoyed the work, of course, and it did not strain my patience, as several of my friends who saw the models thought it would.

My shop has become a paradise for boys whom I always entertain. It is a pleasure to me to hear their comments. They watch me intently as I perform all the details that go to complete the models, and it gives them ideas for making boats of their own. A number of the boys have created several very good models.

Making these ships has helped me in my work for other people in many ways, so I feel that I have a real hobby, one that fills in the time which might otherwise be wasted. To me it is a real recreation.

**By Irving J. Newman**  
**Chicago, Ill.**

*Second Prize, \$10*

MY HOBBY is making and entertaining with Puppen and Judy shows. I am still a senior in high school, but I am from being a professional.

Ever since I was a very small boy, I have been interested in puppet and marionette shows, those operated from above by wires, and those, like mine, worked from below by the hands. I have been building new shows, taking them apart, or improving them, buying new dolls, and writing new plays, ever since I can easily remember. I have given my shows for many of my friends, at charity bazaars, children's

one that is strong enough to support my weight. It is built of two by two inch wooden uprights and crosspieces, covered by a brown and white boxed awning cloth. The whole outfit folds into a suitcase and weighs about 40 pounds.

My 12 dolls were imported from France, and they have elaborate heads and dresses. The performance is the regular old-fashioned combination tragedy and farce, abridged to meet my requirements.

My hobby has furnished me with an interesting, instructive, and useful pastime and has given me a profitable use for my spare time.

**By Olivia M. Kirby**  
**Nyack, New York**

*Third Prize, \$5*

MY HOBBY is sawing wood! Not figuratively, but literally. And the reason I value my hobby is because it brings me that matchless thing—health, which, of course, means happiness and the joy of life coursing through me.

It carries a certain mental satisfaction, too. I feel that I am accomplishing something as I pile up the sawed-off lengths of wood and realize that I shall have plenty of fodder for my two cozy open fireplaces.

There's a lot of exercise besides just sawing the wood. There's the handling of it, the stacking it up and carrying it into the house. Out of it all I get exercise for every muscle in my body and to me it's play, jolly good fun, and I love it.



Olivia M. Kirby limbering her muscles at her favorite hobby—sawing wood



Irving J. Newman, Chicago high school senior, standing beside his puppet show



# Nature's Own Alarm System

## Every Headache a Warning from Your Bodily Machinery

By Edwin F. Bowers, M.D.

**Y**OU are the operator of one of the most elaborate and most important machines in the world. Its working depends on many small parts, any one of which, if out of order, will impair the efficiency of the whole.

That machine is your body. It must see you through life.

Sometimes this machine of yours gets out of order because you abuse it, and sometimes for other reasons. But, unlike the ordinary machine, it never breaks down without warning. These warnings are called headaches. If you do heed them, the machine's efficiency will be lessened, and the fault is yours.

In other words, a headache is not a disease, but a symptom. It is not an affliction, painful though it may be, but a valuable and useful alarm conveyed by the wonderful signaling system of the body.

### Aches of Sympathy

In a broad sense, sympathy alone prompts most headaches. If the liver, the stomach, the ears, the eyes or, in fact, any of the organs that are the cogs in your bodily machine, get out of mesh or alignment, the automatic signaling system connecting them with your head quickly tells the head about it. The head is commanded to ache, and the head promptly and more or less cheerfully acquiesces.

Perhaps the most common form of headache is that caused by wire trouble in your body signaling system—nerve irritation. Loss of sleep, grief, business worries, undue excitement—anything, in fact, that hurts or annoys the nervous system—can and does make the head ache.

### Find the Causes

How to avoid or remove the causes of these aches is your business, for you are operator of the machine. The headache isn't concerned with this. Its job is done when it flashes the pain signal from your hurried nerves. It is your job to discover that you need more sleep and less excitement, that you must avoid worry

And yet many people who have recurrent headaches and are well aware of the cause do nothing to stop them—pay no attention to the frantic signaling of their alarm systems. I knew a man, typical of many husbands, who was much put out whenever he arrived home and found his dinner late. His irritation inevitably led to stormy words with his wife, who, in turn, was irritated because her household routine had been interrupted, and was more than willing to air her wrongs.

The result was that the nervous sys-

tem of both were upset and they went to bed with sick headaches. This happened time after time, still they paid no attention to the protests of their bodies. Similar tactics on the part of a machine operator would cause his discharge in any industrial plant.

Next to nerve irritation, the most common form of headache comes from the fouling of your bodily machine by foreign matter—a process of poisoning arising from the absorption into the circulation of poisons generated in the intestines. These

are among the most dangerous poisons known—twin brothers to the deadly curari with which the Orinoco Indians of South America tip their murderous arrows.

If isolated and injected directly into the blood, these "putrefactive alkaloids," as they are called, would kill like cobra venom. Fortunately, in passing into the blood, their virulence is partly neutralized and overcome. But they are poisonous enough. Their presence in your bodily machine should tell you as operator that the machine is clogged through constipation and requires cleaning. A mild course of cathartics perhaps is the most useful way of ridding the body of these poisonous waste products.

### The Poison of Fatigue

The bodily machine may also be fouled by being overworked. Overwork causes fatigue poisons to accumulate in the blood faster than the red cells can burn them up. The result is the kind of headache to which those who do confining indoor work are particularly subject—a dull throb that comes from muscle weariness.

The head is imperatively demanding that the bodily machine be given a period of rest—a chance to cool down and thereby destroy the poisonous debris that has been accumulating. In other words, the time has come for you to shut off the power from your machine. If you are a competent operator, you will do it.

### Fresh Air Needed

A well-known actor came to me not long ago seeking relief from recurring headaches. He had diagnosed his trouble as due to the nervous strain of perform-



Nervous strain

Close reading

Overeating

Flickering movies

A headache says Doctor Bowers is not a disease, but a valuable alarm, warning of a fault somewhere in the bodily machinery. Common causes of these painful danger signals are shown in the illustrations and listed below.

### Ten Reasons Why Your Head Aches

1. **Nerve irritation.** You need more sleep, less worry, or less excitement.
2. **Poison.** Your body machine is clogged with waste. It needs cleaning out.
3. **Overwork.** You need to shut off power and let the body machine cool down.
4. **Stuffy rooms.** Your body needs a fresh-air bath.
5. **Biliousness, "sour stomach."** Eat less fried foods, pastries, starch, sugar.
6. **Overeating.** You're feeding your body more fuel than it can consume.
7. **Eyestrain.** Avoid glaring lights and prolonged close work.
8. **Eye defects.** You need the services of a mechanic—an eye specialist.
9. **Overstimulation.** Drink less coffee and cut down on your smoking.
10. **Decayed teeth.** You need to visit your dentist more regularly for repairs.



ing a particularly exacting rôle during a long run. That might have caused his headaches, but as a matter of fact it had not—not entirely. His bodily machine had become clogged because he had been inhaling impure air night after night.

It happened that the theater in which he had been performing was poorly ventilated. The result was that he had not been taking in sufficient oxygen to overcome the poisons that his bodily machine generated as it worked. On the contrary, he had been aggravating the condition by breathing carbon-dioxid poisons emanating from the several hundred other human beings who made up his nightly audiences.

His sort of headache may be described as the "stuffy room" headache. It is a sign that the bodily machine needs a fresh-air cleaning.

### Time for Repairs

Biliousness is another cause of headache—headache absolutely maulish in its obstinacy. This form of headache is an indication that the bodily mechanism is out of adjustment and requires overhauling. Dieting, copious flushing of the digestive units of the machine with lemon water, or some mild alkaline liver stimulant, usually gets the machine to working right again and causes the headache which gave warning to disappear.

Somewhat similarly "sour stomach" will produce headache—once again an indication that the bodily machinery is clogged. Abstinence from fried foods, pastries, and excess of starches and sugars, as well as an occasional dose of milk of magnesia or some other efficient alkali will correct this condition.

Too much fuel in your bodily furnace—in other words, overeating, causes the alarm system to flash a headache warning. This is due to the poisonous material generated by the fermentation of too much food, or too much of the wrong kind of food. Elimination of the poison by cathartics and a lessening of the fuel supply usually will end the headaches.

### Eyestrain a Cause of Headaches

Eyestrain probably is the next most frequent cause of headache. This is another form of overwork to which your bodily machine objects. Exposing the eyes to the glare of sand, sea, or unshaded incandescent lights; prolonged focusing on a flickering moving-picture screen, intently watching a brightly lighted stage from an unnatural angle; sewing, reading, writing, and other forms of close application continued for hours on end—any one of these will bring a violent and enduring headache.

Or the muscles of your eyes may be out of balance—a defect in the construction of your machine. In this case to relieve your headache you will require the services of an expert mechanic—an eye

specialist. Your machine needs mechanical repairs, which means an operation; or new power, which means eyeglasses. Since medical science computes that fully one third of the total functional activity of the brain is expended in receiving and conveying eye impressions, it is not surprising that an extra strain upon the eye muscles produces an unfavorable reaction.

If you suffer from chronic headache and cannot trace it to its cause by inspecting your bodily machine according to the

termining the presence of hardening of the arteries and kidney disease in their early and curable stages.

It may be that your headache comes from your habit of "doping" your bodily fuel, as automobile men say. Too much coffee drinking is likely to produce headache, for coffee contains an alkaloid called caffeine, which is an active stimulant. Up to a certain point coffee may be a most useful and beneficial stimulant or tonic, but too much may be harmful, especially if taken at night in sufficient quantities to produce insomnia, or disturbing restless dreams. Abuse of tobacco also may cause overstimulation that manifests itself in the form of headache.

### A False Argument

A business man whom I had for a patient recently, objected when I attributed his headaches to his habit of drinking eight or 10 cups of coffee every day and consuming heavy cigars in constant succession.

"But, doctor," he said, "I've been doing that for 20 years!"

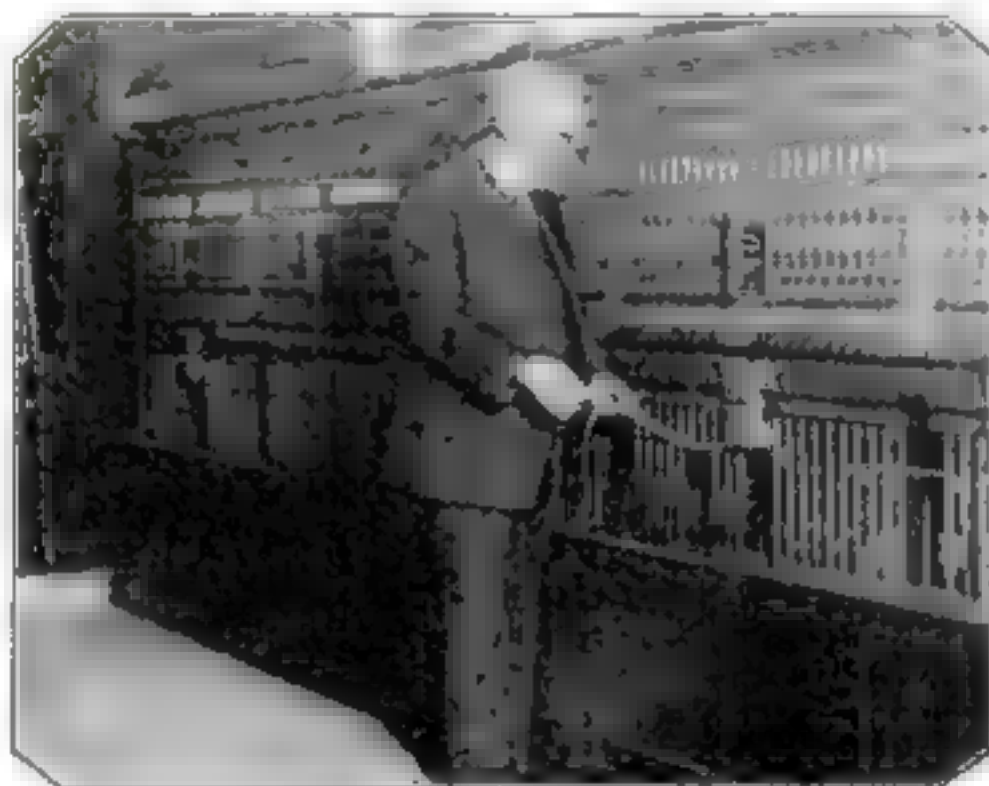
That is an argument frequently advanced to physicians who advise patients to change their accustomed mode of living for the sake of their health. It is illogical, of course. If nature has been kind enough to permit you to pursue an un-

hygienic, if pleasant, course of life without causing you pain, it gives you no license to affront nature by continuing your unwholesome habits after nature has sounded a warning.

Decayed teeth are not infrequent causes of neuralgic headaches, as they are of many more serious illnesses. In this era of competent dentistry and free dental clinics there is no logical excuse for such poisoning.

Catarrh and long-continued irritation of the nose cavities from a twist in the partition that separates them; enlarged bones, or thickened mucus membranes are prolific sources of headaches. If the cause is merely congestion of the nasal membranes, strong pressure on the center of the tongue morning and evening with a tongue depressor often will give relief to the sufferer.

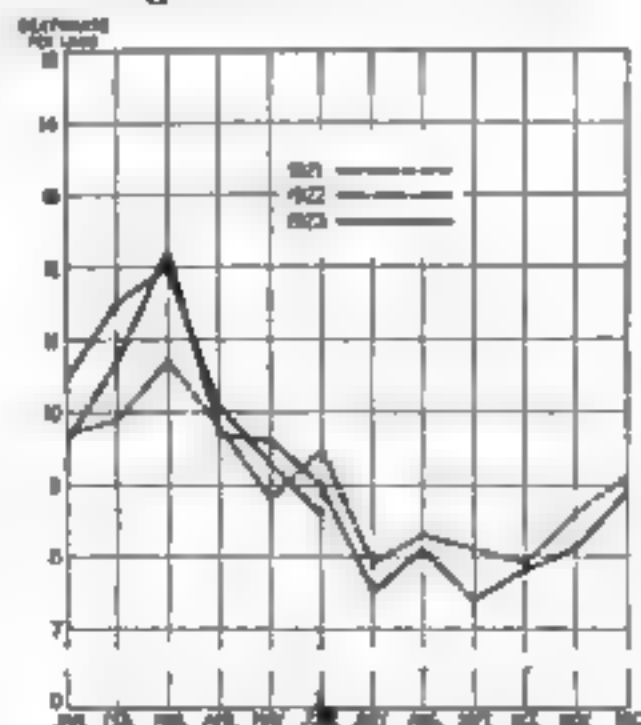
So it is apparent that headache invariably means something besides a headache. If you will take the trouble to find out what this something is and remove it, you will be convinced of what I said before—that headache is the most useful pain you can have. However else headache may be treated, it never should be treated with contempt.



The most scientifically equipped fire-alarm telegraph station in the world, recently established in the Borough of the Bronx, New York, is no more sensitive or efficient than the headache alarm system with which Nature has endowed the human body. Yet there is this vast difference between the two: The fire alarm brings prompt and ready response, while the warnings of danger flashed from our bodies too often go unheeded by us until the damage has been done.

suggestions I have given here, it would be well to call in a doctor and let him make a urinalysis and a blood pressure test to determine whether your kidneys are acting normally. If you lead a sedentary life and eat much meat, you should do this at least once a year. Many hundreds of lives would be saved annually by thus de-

### Danger Points of the Year



This chart of the Metropolitan Life Insurance Company based on the death-rate records in the United States for the last three years, clearly shows the high danger points of the year—February and March. The peak is reached the first of March. This is the time of year when headache warnings should be heeded most closely.

**HOW** would you like to add 20 years to your life? Medical science says it can be done, and has provided the means by which you can do it. An unusually interesting article on the subject by James E. Tobey, executive secretary of the National Health Council, will appear in the May issue.



## In Armor of Nails, Hunter Will Battle Wolves

**E**NVELOPED from head to feet in a suit of armor spiked with a thousand nail points, Stanley Carlson, of St. Paul, Minn., is venturing into the wilds of northern Ontario to meet and conquer hungry wolf packs in hand-to-hand combat.

The armor is the invention of the knight of the open places. It consists of a cowhide suit through which more than 1000 nails have been driven with their points projecting outward; helmet and gloves with similar spikes, and a wire mask resembling that of a fencer. The armor weighs only 27 pounds.

The suit is fastened in front with strong metal clasps. In his right hand the hunter carries his trusty double-bladed



The wolf hunter in his nail armor

ax, while a dagger-like hunting knife reposes in one of the clasps at his waist.

Standing unharmed in the midst of a hungry wolf pack, Carlson expects to strike them down with his ax and finish them with his knife. He believes that the high government bounty on wolves will make his invention profitable.

## A Strange Shouting Fish

**A** NEW species of fish that is brilliantly illuminated and that makes a loud shouting noise when chasing smaller fishes has been discovered in the waters of Monterey Bay, Calif., according to Dr. C. W. Greene, of the University of Missouri. Its ability to shout is due to the peculiar construction of its swim bladder, he says. The noise is produced by gaseous contents of the bladder.

The fish is said to carry 360 phosphorescent lights.



## Across Niagara's Whirlpools in a Cable Car

**O**NE of the most exciting of the world's perfectly safe trips is a ride in the cable car that carries Niagara visitors across the river above where the foaming waters swirl viciously in the famous

Whirlpool Rapids. The car, riding from a wheeled carriage that rides along a series of cables, glides smoothly nearly 200 feet above the boiling current, affording an exhilarating thrill.

## Horses Give Their Blood for War on Diphtheria

**B**LOOD in small quantities from two horses, Charlie and Jim, owned by the United States Public Health Service, is used to set the standard against for a diphtheria antitoxin made in the United States.

Powerful, they have blood that thoroughly tests the efficacy of the antitoxin. For six years they have done this bravely, saving the lives of thousands of babies. They are content, apparently being satisfied that they have a snug and easy berth.

Every four months government health officers call upon them for blood.



Charlie and Jim, Public Health horses



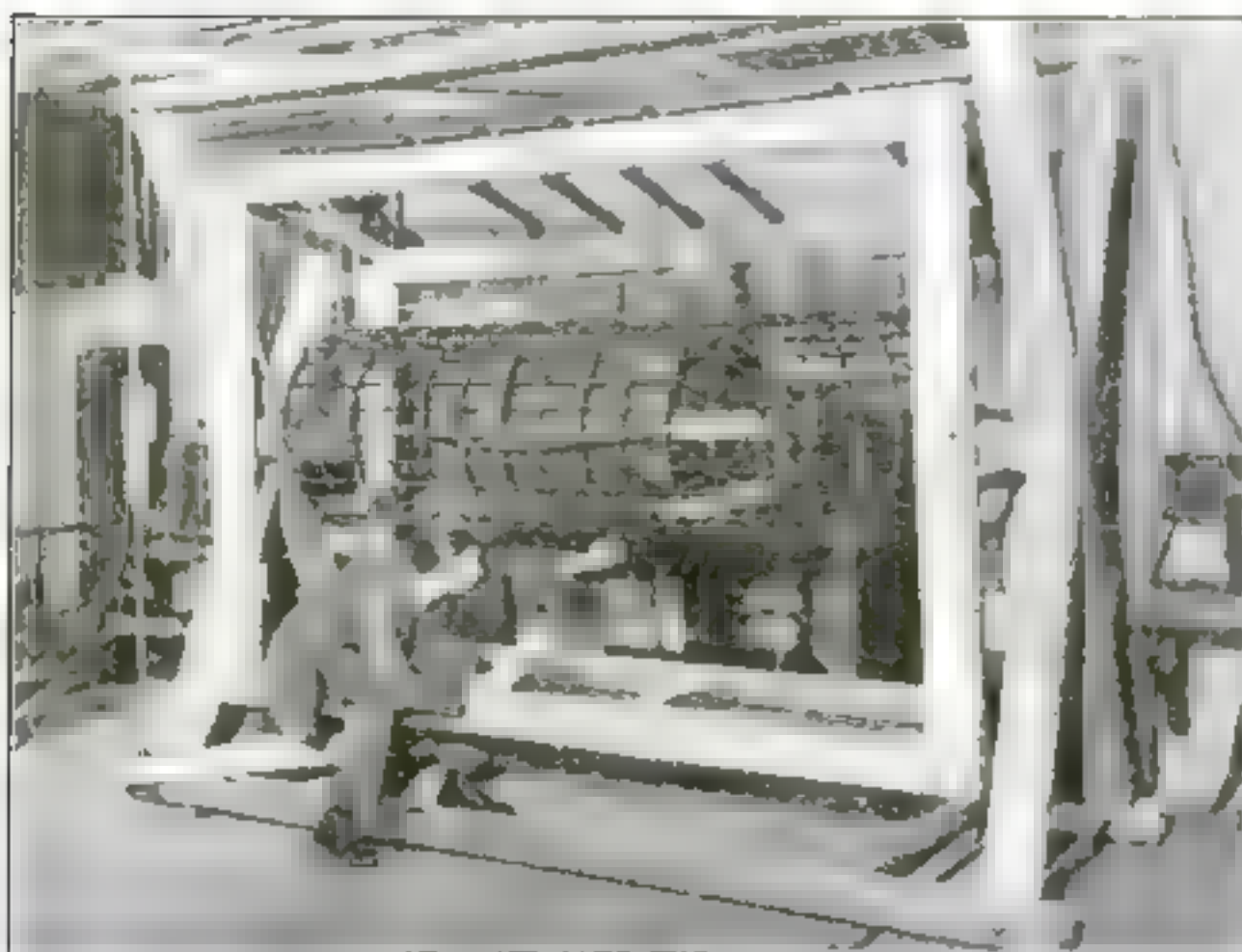
## Will You Be Able to Do This when You Are 70?

**A**T THE age of 70, Tom Onko, nationally famous walker and specialty acrobat, still can scratch the top of his head with the toe of his shoe.

He attributes his agility to the habit of regular and strenuous exercise. In the last 40 years he has walked many thousands of miles, traversing every state in the Union.

He formerly was with Ringling Brothers' circus and also was a vaudeville performer.





## Model of Great Dirigible Tested for Strength

PLAYING polarised light through a celluloid model of the navy dirigible *Shenandoah*, formerly the ZR-1, scientists in the laboratories of the Massachusetts Institute of Technology have been finding for 10 months the structural secrets revealed by the rainbow lights that appear at stress points.

The phenomenon of photoelasticity, the latest of safety tests, now is recruited to prepare the great airship for her proposed

flight to the North Pole next summer, and to prevent a repetition of the disaster that overtook the ZR-2, the *Roma*, and more recently the French ship *Dirigible*.

The model consists of several thousand celluloid pieces, machined precisely to scale and fitted into an accurate miniature of the great ship. Since celluloid acts

## Safety-Razor Blades Honed and Stropped Quickly

AS HAVE every day for six months—182 shaves in all—with the same safety-razor blade, is the feat said to be possible with this new honing and stropping machine.

For honing, the blade is set in a carriage that, moved back and forth, presents alternate edges to an emery block. At the end of each second movement, an ingenious arrangement reverses the blade, so that the process is repeated on the other side.

For stropping, the blade is inserted on the opposite side of the machine, which has a stropping block.



Stropping a blade



A Midget Car for Two

## Portable Acetylene Lamp Designed for Safety

A PORTABLE light for night work, said to be safe and powerful, is provided in a novel acetylene generator. Even if knocked over, no addition of gas will result, it is claimed.

Unlike the action of most carbide generators, small quantities of carbide are dropped into an amper container of water. Usually it is the water that is dropped on the carbide.

The lamp is said to furnish 5000 candlepower. Since the weight of the light is mostly at the bottom, it is said to stand safely on a 30-degree slope, without interfering with generation.



The powerful lamp is carried easily



## Camera Support Made from Two Hunting Knives

INGENUITY and a pair of hunting knives substituted successfully for a camera tripod when W. L. Thompson of Dublin, Tex., tried for an especially good time-exposure photograph of a recent hunting trip.

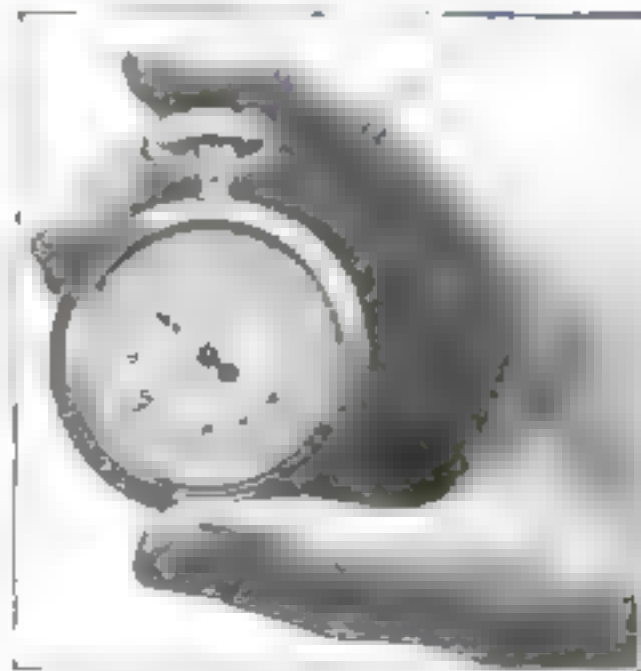
The points of the knives he stuck into a tree trunk in such a way that the handles formed a level and firm support for the camera.

The "knife tripod" thus was prepared for action more readily than would have been possible with an ordinary folding tripod and eliminated an extra load.

IT MAY not look like one, but it's an automobile, even to the self-starter and spare tire. In fact, it's a German-made car. It has virtually every mechanical feature found on large cars. The upholstered seat carries two.

## One-Hand, 40-Hour Watch

THIS one-hand watch is said to run 40 hours, simply because it does not have to drive a minute hand around the dial 2 times a day. The watch face is marked on a hour divide into five-minute intervals, each of which is numbered.



One-hand watch, showing dial divisions



# Straw Gas for Light, Heat, and Power on the Farm

**STRAW** soon may be lighting the farmer's house, cooking his meals, substituting for coal in winter and even running his automobile. The United States Bureau of Chemistry has discovered a practicable method by which a ton of sun-dried wheat straw is said to yield 10,000 cubic feet of illuminating gas, 10 gallons of tar, and 625 pounds of carbon residue, which is an excellent fuel. The gas is said to burn successfully in a mantle lamp, producing a blue flame restful to the eyes. Experts of the bureau also claim that it can be used efficiently to operate a stationary internal combustion engine.

They estimate that 300,000 cubic feet of straw gas would do the cooking, house lighting, and heating on the average farm for a year. Of this amount, 55,000 cubic feet would be used for cooking, 19,000 for lighting, 201,000 for heating the house, and 25,000 for heating water. About 235 cubic feet would be used daily during the summer and about 1750 in winter.

From 45 to 50 tons of dry straw would be needed to produce this quantity of gas, assuming that straw would be used as fuel in distilling the gas. If wood were used, less straw would be required. Half a ton of straw burned in the firebox will carbonize one ton of straw in the retort. Experts of the Bureau of Chemistry have designed a special retort for the



Retort for making straw gas on the farm, devised by the Bureau of Chemistry

process in order to obtain heat and the by-products mentioned.

The gas bubbles up through water and then through fine-meshed screens and a layer of coke and charcoal. Thus purified, it passes to a storage chamber

According to the bureau, straw gas holds possibilities as automobile fuel. Cars have been operated by it experimentally, the gas being carried in a rubber bag. One car carrying 300 cubic feet of the gas ran 15 miles with no other fuel.

## Studio Bed Folds into Attractive Table

**A COMBINATION** table and bed that makes two rooms out of one, is one of the ingenious new furniture combinations devised for the small home. It requires no wall space and can be used in any room. The double bed is complete, with springs, mattress, and bedding that, when folded into the table, are out of sight.

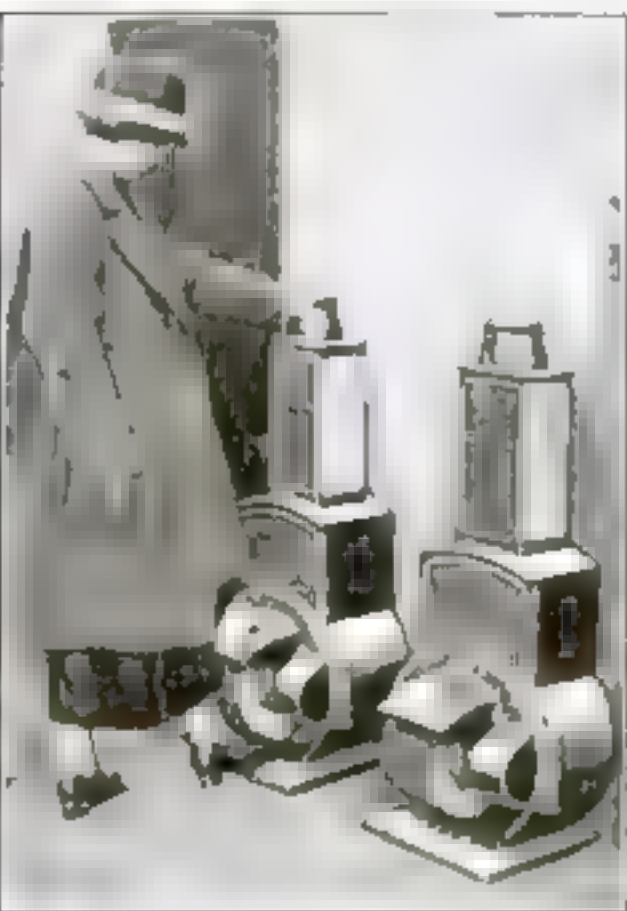
The table is an attractive piece of furniture for the living room, in the daytime, without betraying the slightest indication that it can be converted into a bed. When unfolded, the top of the table is raised to form the head of the bed. The table legs support the head of the bed, while the foot rests on unfolding supports.

The bed is said to be four inches longer than the ordinary size and the same height from the floor. It is especially designed for convenient use in small apartments, apartment hotels,

or studios where space is limited. There is no need for a closet for bedding, since the table serves as a closet in itself.

## Dyed Shoes Poison Wearer

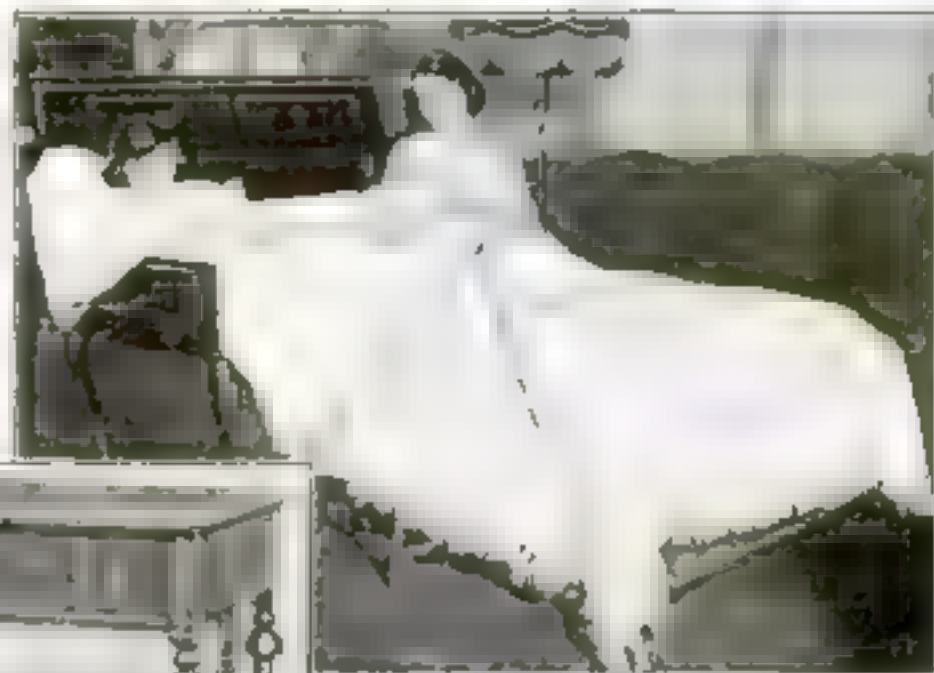
**SHOES** dyed with materials containing aniline or nitrobenzine will poison the wearer unless they are allowed to dry at least 24 hours before being worn, declares Prof. A. S. Lovenhart, chairman of the Department of Pharmacy at the University of Wisconsin. The person so poisoned becomes blue, particularly on the lips and fingertips, he says.



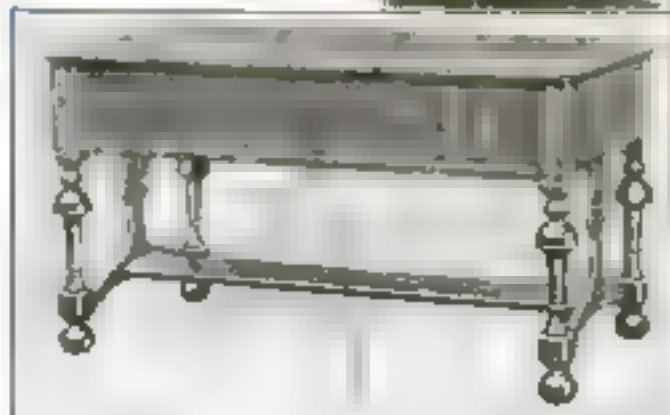
## Shoes Shined for a Penny by Slot Machine

**DUST** and mud are cleaned off the shoes of pedestrians in a jiffy by an ingenious penny-in-the-slot brushing machine that recently made its appearance along the sidewalks and in public places of some of the large cities throughout the country.

You simply place your shoe beneath a rotating brush at the base of the machine and insert a penny in the slot. The penny immediately operates a switch that starts an electric motor. The motor whirls the brush for a full minute while the customer adjusts his foot to the best advantage.

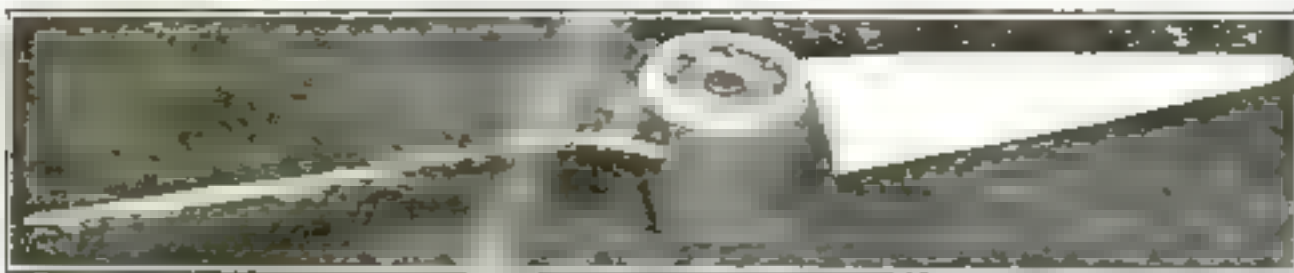


Above: The table unfolded to form a comfortable double bed for the small apartment. The top of the table is lifted upward to form the back of the bed. The foot rests on two sets of unfolded supports as illustrated.



Folded into a table for daytime use.





## All-Metal Propeller for Airplane Safety

AS A result of experiments with sound vibrations, S. A. Reed, of New York, an expert in acoustics, has produced what is said to be the first successful all-metal propeller for airplanes. The inventor claims it is little affected by atmospheric conditions and assures greater safety to aviators.

The Reed propeller is of duralumin. Tests have demonstrated that, compared with a wooden propeller, it develops from two to five per cent greater efficiency in

straightaway flying, and from three to 10 per cent in climbing. This is due to the fact that it is constructed of a single metal plate of uniform thickness, making it one working section.

The danger of breaking a frail wooden propeller in flight always has constituted one of the principal hazards of flying. The duralumin propeller, it is claimed, can pass unharmed even through a hailstorm that would shatter a wooden propeller to bits.

## Driver Sleeps in Three-Wheel Touring Car

NARROW roads, crowded hotels, or stormy weather would be a concern but not the motor tourist touring in this new three-wheeled car, exhibited at a recent motor show in Germany.

The hood-mounted driver provides sleeping accommodations. The car has speed lines and is designed for cross-country touring.

Power from the small engine is transmitted to a single drive wheel at the rear.



The streamlined hood provides sleeping quarters for the driver.

## Automatic Oil Feed for Ford Crankcase

TO INSURE a proper level of oil in Ford crankcases, the new automatic oil feed system automatically feeds the fluid from a three-quart reserve container.

Oil is fed into the crankcase through a float chamber containing a hollow metal float.

This float controls an oil intake check valve at the top of the float chamber. As the level of oil in the crankcase is lowered—lowering the level in the float chamber correspondingly—the float opens the intake check valve, permitting enough oil to enter to restore the correct level.

When the surplus supply is exhausted and the level in the crankcase begins to fall, a wafer float in the lower part of the chamber operates an alarm connected with the magneto terminal.

## Cheaper Dynamite Made from Sawdust

DYNAMITE that can be manufactured cheaply from sawdust has been invented by Prof. William M. Dehn, University of Washington, Seattle. He claims it will insure farmers of the Pacific Northwest a permanent and inexpensive medium for blasting stumps from logged-off lands.

The State Grange is reported to be making plans for the manufacture and distribution of the new powder.



Demonstrating the automatic oil feed.

## Gas-Jet with Safety Valve Prevents Accidents

ACCIDENTAL use of gas jets is said to be impossible in rooms where gas-jets are equipped with a new, invented safety tip. So also are explosions of gas escaped from the jet.

The tip can be removed from the jet only when the jet cock is on, only if a lighted match is held close to it. The action is automatic.

An arrangement of fine wire, of a metal that contracts and expands markedly with temperature changes, controls a ball that blocks the outlet of gas. As long as this wire is cold, the ball will allow no gas to escape.

But if a lighted match is held near the jet tip, the heat will cause the wire to expand, pushing the ball from the narrow opening it blocks. The gas then rushes through the tip.



Match flame frees gas.

## Portable Electric Motor Is Air-Cooled

USUALLY, when an electric motor is running, it is considerably too hot to be held uncovered in the hand. A newly perfected portable motor, however, is provided with a specially designed air intake that keeps it cool enough to prevent burning the fingers. It is shown in the illustration below operating an electric shaper on a jewelry case.

This ingeniously designed little motor is said to develop one eighth horsepower and to run 1500 revolutions a minute under full load. Without a load, it runs 18,000 revolutions a minute. It is said to develop more power for its size than any motor before designed.



Air-cooled motor driving a shaper.





### Road Paved with Cast-Off Solid Rubber Tires

A ROAD surface of rubber blocks cut from discarded solid tires has been laid in Bradford, England, as an experiment. The stretch of paving is in front of a court house, the proximity of which to the street always has made the noise of passing vehicles particularly annoying. The cost of the pavement, it is estimated, was about \$3 to a square yard.

The rubber was stripped from the metal rims of the tires and cut into pieces about 2½ inches square by 11 inches long. The pieces are held in position with pitch or tar, as are the wood or stone paving blocks heretofore used.

### Compact Cabinetmaker Does Work of 10 Men

THE work of 10 men is said to be equalled by an unusually compact mechanical cabinetmaker, which requires only a one-horsepower motor. The machine is declared almost as versatile as larger machines designed for similar purposes.

The rip gage is used right and left, and also as a guard over the circular saw. The saw table will tilt to an angle of 45 degrees. A hand wheel adjusts the projection of the saw above the table.

Pressure rollers hold work firmly on the table when planing is being done.



Ripping stock with the circular saw



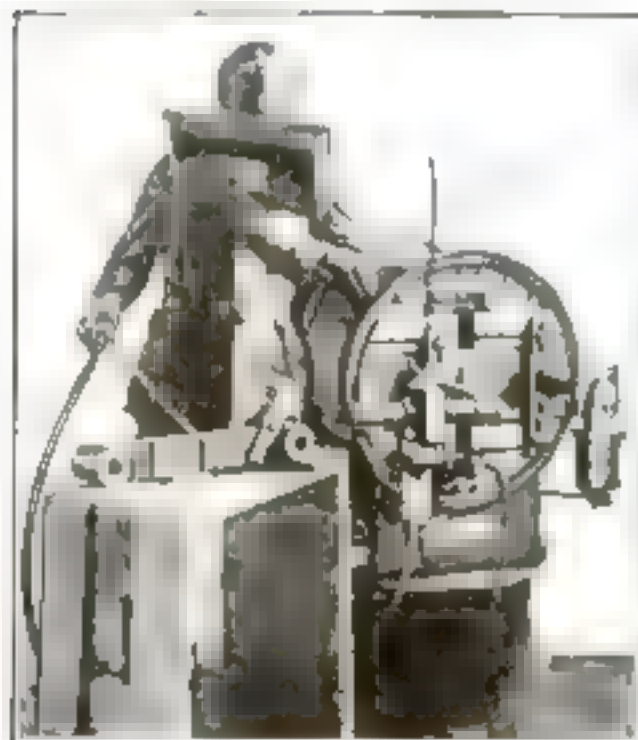
### Old Blast Furnace Felled by Dynamite Discharge

TWENTY slender sticks of dynamite felled this blast furnace, said to have been one of the oldest and largest of its kind in the country, at Pottstown, Pa., when its owners decided that continued dismantling would be too slow and costly.

Eight hundred tons of masonry tottered with a queer, dizzy motion, then crashed with an earth-shaking roar.

A new furnace, embodying all modern innovations, will be upreared on the same spot.

The above photograph shows the towering structure just after the explosion.



### Electric Machine Does Welding or Forging

THIS universal machine is said to combine an electric forging hearth, a butt-welding machine, a spot-welding machine, and an arc-welding machine. By turning the revolving portion, it is transformed from a spot-welding machine to a forging hearth. By inserting two plugs and attaching a lever, it becomes an arc-welding machine.

Alternating electric current supplies heat and power.

### Gage Measures Rotating Work

TO PERMIT measuring work while it is being rotated in a grinding machine, Philip S. Arnold, of Flint, Mich., has invented an ingenious automatic micrometer gage.

The gage, designed to be used in a grinding machine, is equipped with two jaws that automatically measure the diameter of the work. The measurement of the diameter will not cause any deflection of the recording needle. When the machine believes the work has reached the required diameter, he grasps the handle, depresses the entire arm and presses on the grip. This lowers the lower jaw and raises the upper jaw, thus permitting their adjustment so that the work is between them.

By releasing the handle, the upper jaw takes a definite position with respect to the lower one, according to the diameter of the work. If the previously set needle still registers zero, then the work is accurate.

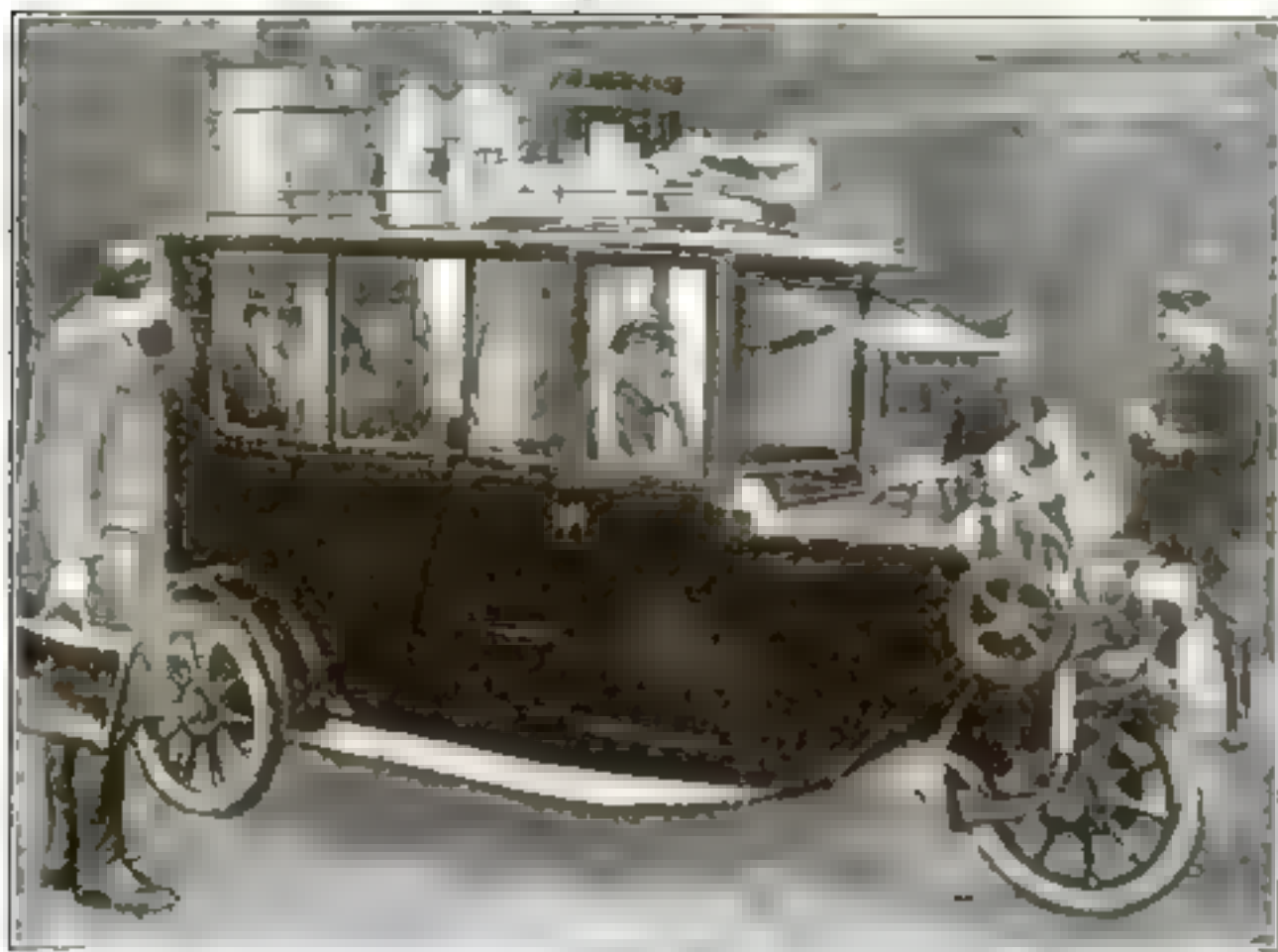
The arm swings in a loose joint.



Above: The micrometer gage showing clamp that holds it to the bed of the grinder and the operating handle and grip

At the left: The gage jaws measuring the diameter of work while it is revolving on the grinding machine





## Motorcycles Transformed into Mail Coaches

TO MEET the situation created by the suspension of rail service to many parts of Germany, because of the coal famine, the German post-office department has made over several hundred motorcycles into odd, three-wheeled cars of the type shown above. Besides carrying mail, they more than support themselves by conveying passengers.

The motorcycle motor, of four cylinders, gives the car a maximum speed of 35 miles. A second carburetor is built in front of the engine, which is exposed in front of the car. This carburetor uses a low grade of oil, which is preheated by the exhaust gases. Such a motor arrangement is said to make the operating costs less than half those of an automobile with the same capacity and speed.

The car accommodates the driver and five passengers. Mail and packages are carried on the roof in a railed inclosure where they are out of the way of the passengers.

## Eagle a Model Husband

THE married life of the American bald eagle presents a model of constancy to the people of the land of which it is the symbol, according to Prof. F. H. Herrick of Western Reserve University. But when the eagle's mate dies, a new marriage is contracted and the new mate takes up its residence in the old nest, he explains. The same nest therefore may be used for a very long time by the successive members of the family partnership.

## Mechanical Secretary Takes Telephone Calls

A NEW instrument known as the telegraphon, recently has been put through successful tests in Germany in



Above: Listening to a recorded message recorded and repeated by the mechanical secretary. At right: The business man at a telephone. A microphone on his desk to be received and typed by a stenographer in another room.



taking and recording telephone messages automatically, in taking dictation and in recording minutes of meetings.

The machine combines the principles of dictating machine and the telephone. A telephone call comes in during the absence of the one for whom the message is intended, the telegraphon acts as a secretary to take the call. Upon the return of the absentee, he places a pair of receivers over his ears, turns on the machine and hears the complete message.

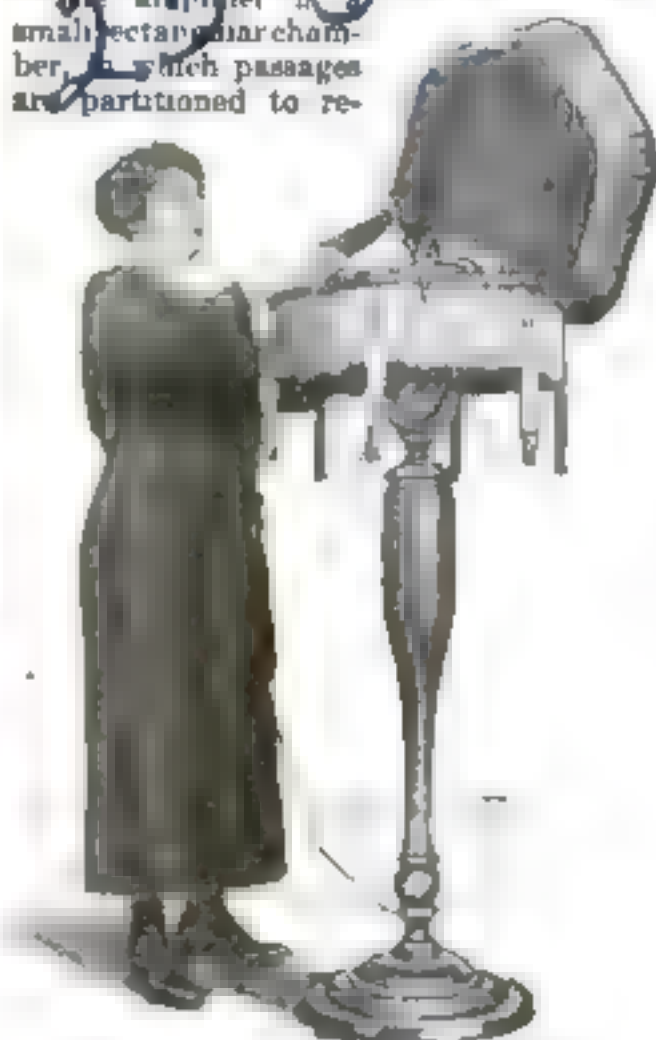
When used in the office for taking dictation, the machine can be placed near the stenographer's desk in a distant part of the building while the dictator can remain seated at his desk.

By the use of a microphone in the dictator's office the sound of his voice can be amplified sufficiently for transmission over the wires to the machine. This permits several people to dictate to the same stenographer.

## Floor Lamp and Talking Machine Combined

LIGHT and music are dispensed by the phonographic floor lamp pictured below. Removal of the top of the shade exposes the tone arm and record table. An electric motor beneath the fringe of the lampshade runs the talking machine.

The amplifier is a small electric chamber, in which passages are partitioned to re-



Placing a record on the talking lamp

semble the mechanism of the human throat. The lamp bulbs under the fringe are lighted, as is usual, by pulling two wiken cords. Plugging in the connection operates both lights and phonograph.

Power and light for the combination device are obtained through a wall plug.



## All-Metal Hair-Brush Is Easy to Keep Clean

THIS hair-brush is entirely of metal, the back and handle of aluminum and the bristles of fine, silvered steel wire. Strange as it may seem, the metal bristles are said to give a delightfully smooth sensation to the scalp.

The back of the brush is perforated with slots which, besides giving extreme lightness, make it easy to clean. A brief bath of boiling water is said to cleanse the brush thoroughly.

The makers claim the brush will last a lifetime, since it is unaffected by moisture, and that the effect of the wire bristles is beneficial to the scalp.



## Motor Truck Moves Garage a Mile on Its Back

LIKE a grotesque member of the tortoise family, this motor truck recently traversed the streets of Muskegon, Mich., carrying a garage on its back. In this way the structure was moved more than a mile, resting on timbers placed across the frame of the car. The garage was lifted by jacks.



Moving the garage by motor truck

## Filling Station Computes Gasoline Bill

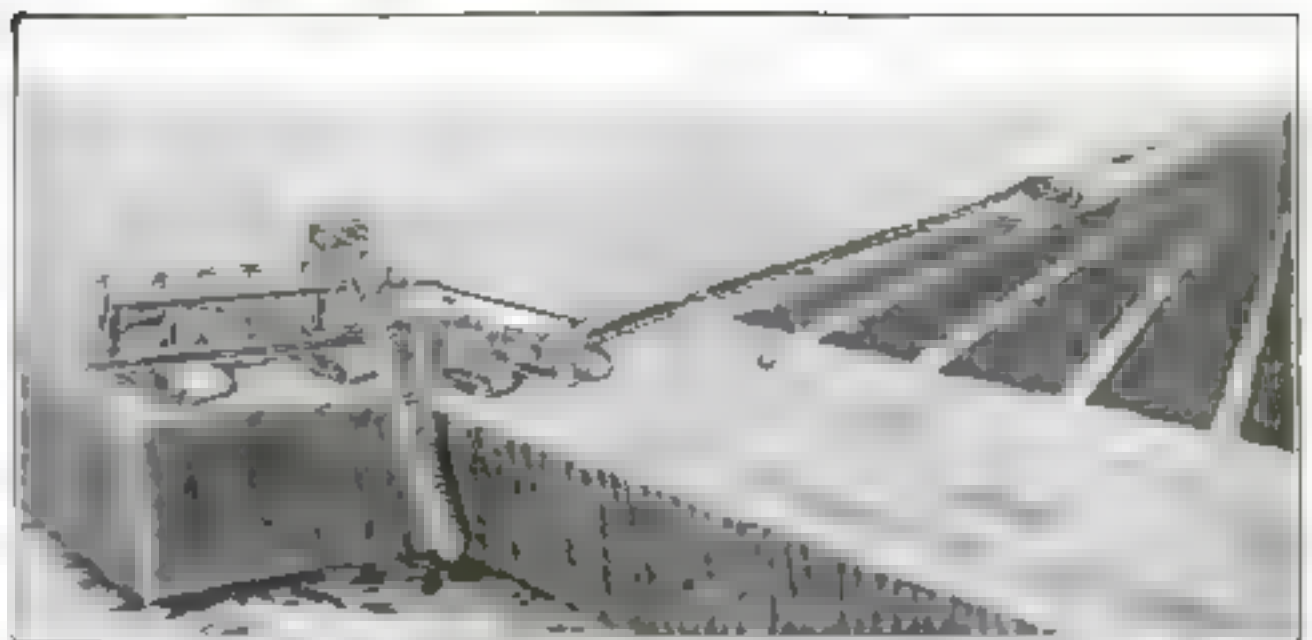
THE quoted price of gasoline a gallon, according to grade, as well as the total cost of any specified number of gallons (from two to 16) at that price, are displayed for automobilists by a newly patented price semaphore for filling stations. The twist of a key automatically alters the figures according to price changes.

The device has a price range of from 15 cents to 25 cents a gallon, including half-cent reductions. It is easily and quickly attached, and the numbers can be read by a motorist seated in his car 10 feet away.



The gasoline price semaphore. The table of prices at the right, computed at 25 cents a gallon, appears in the space opposite the column of figures indicating the number of gallons.

25  
24  
23  
22  
21  
20  
19  
18  
17  
16  
15



How the giant machine, on endless treads, harvests peat and spreads it to dry

## Machines to Harvest Vast Canadian Peat Bogs

NEARLY 40,000 square miles of peat bogs, from five to 10 feet deep, soon will be harvested in central Canadian provinces that, because they lie too far from the Dominion coal areas, have depended upon United States mines for fuel. To accomplish this, the Canadian government has spent nearly five years of research and more than \$500,000 developing machinery and a digging and drying system.

The process consists of excavating, mixing, grinding, and finally spreading the peat on a drying surface in cut blocks. In from 20 to 40 days the fuel is sufficiently dried. The plant consists of four specially devised machines—an excavator, a belt conveyor, spreader and harvester.

The excavator is a steel frame on endless treads, supporting digging buckets moving on an endless chain. The excavator can be adjusted to cut any desired depth and is highly mobile because of its ingenious caterpillar base. Only two men are required to operate it.

The conveyor is 860 feet long, of fabricated box girder in 10 sections, also mounted on endless treads. A belt con-

veyor runs through the bog, carrying the peat to the treating mill. From the mill the belt conveys it to the drying fields.

The spreader, also moving on endless treads, runs parallel and near to the conveyor. The spreader has an extended hopper that is fed from the conveyor.

The entire plant thus moves as a single unit on endless treads, cutting the peat and leaving full drying fields behind it as it advances.

## Fruit Made Sweeter by Sealing Up Cores

BY SEALING up the blossom end of apples, pears, quinces, and crab-apples, sweeter and better flavored fruit can be produced and "core rotting" retarded, according to Prof. Brooks D. Drain of the Massachusetts Agricultural College.

Since the core acts as a ventilator, the chemical changes that accompany ripening occur most rapidly in the core part, resulting in decayed centers, he said. Closing the ventilator preserves the core.

## This Player Piano Is also a Banjo Instructor

FAIR proficiency on a mandolin, banjo, ukulele, or similar stringed instrument within a few hours is a result claimed by the inventor of a new kind of piano music roll, which acts as a mechanical music teacher.

It differs from the ordinary roll in that along the left margin at varying intervals, are printed diagrams representing the upper section of the finger board of the instrument being played. On each diagram are printed numbers in circles, indicating where the fingers corresponding to the numbers are to be placed in order to produce a chord that harmonizes with the piano music.

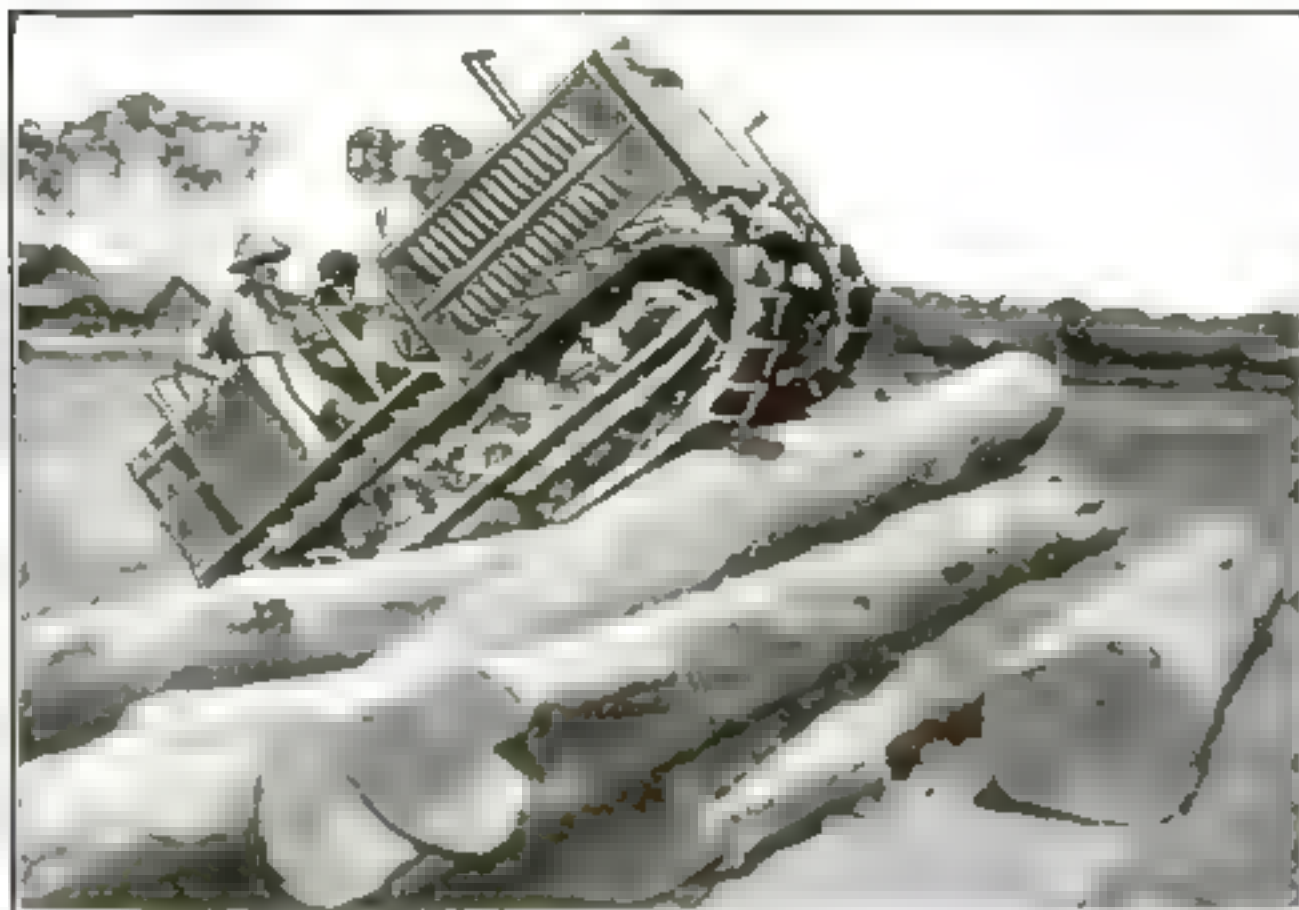
The player first tunes the instrument to the piano. Then he starts working the treads of the piano. As the first diagram comes into view, he places the proper fingers on the designated frets and strums. Each new



On the music roll appear fingerings of chords for banjo or ukulele

diagram indicates a change in the chord. The words of the song are printed along the right margin, as on the ordinary roll. Several beginners can practise together.





## Tractors Take Job of Elephants in India

THE teak-piling elephants of India, remembered by Kipling in "Mandalay," are threatened with extinction by the inexorable efficiency of man's mechanical inventions.

One of Burma's largest lumber companies, after careful and extensive tests,

has adopted American endless tread tractors to pile the teak logs. The machines are declared to be far cheaper to house and feed than the vast, leisurely elephant and to pile many more logs a day. Moreover, they are by no means so temperamental.

## "Thermometer Clock" Has only One Hand

RESEMBLING a thermometer, an oblong clock with a single hand is the latest innovation in timepieces.

The space between each hour number is divided into minute units. Smaller figures mark the 15-minute periods. A pointer traveling in a slot between the columns of figures, is attached to an endless chain actuated by a mechanism at the bottom of the case.

When the pointer reaches the bottom, it turns and starts upward, pointing in the opposite direction.



## Paper Cabinet Saves Time for the Typist

THREE sheets of paper, one for the original letter, one of carbon paper, and one for the copy, are presented a stenographer in the proper order and position at a touch of the lever in this newly patented cabinet.

The usual way of storing these papers in the drawer of a desk often crumples or soils an expensive quantity. This is particularly true of carbon paper. Often, too, the typist attempts to use a slightly spoiled sheet, not noticing the defect perhaps until she has completed a letter.

## The Sea's "Cold Wall"

WHERE the Gulf Stream and the iceberg-laden Labrador Current meet off the Grand Banks of Newfoundland, extreme differences in the temperature of the sea water often are observed over short distances. This dividing line is known as the "cold wall."

While on ice patrol duty, a United States coastguard cutter found itself across the "cold wall." The water temperature at the bow was found to be 34 degrees, while that at the stern was 56 degrees.



The oblong clock, showing single pointer

## Case for Medicine Bottle Prevents Spilling

HAVE you ever opened your trunk or suitcase at the end of a journey to smell a strong odor of medicine and see a brown or black liquid oozing from some of the bottles? This

newly patented

case is

just such

a catastrophe.

The top of the metal case

grips the bottle stopper.

Behind a cork disk in this top is a small spring

When the top is snapped into place, it holds in the stopper

securely, preventing the contents from leaking and doing damage



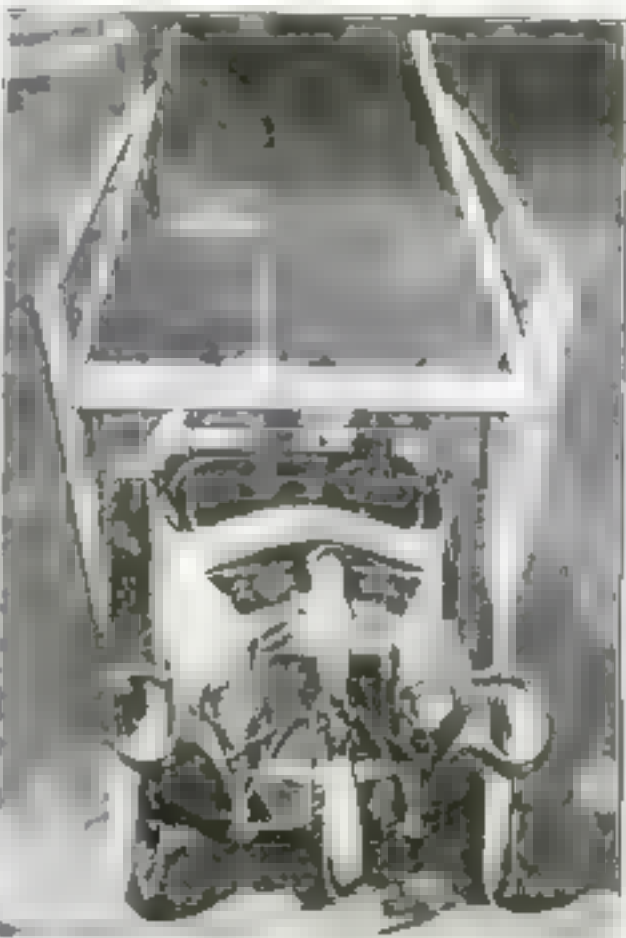
Cap holds the stopper

## Automobile and Airplane Combined in Model

TO DEMONSTRATE his idea of a combination automobile and airplane which, he hopes, will soar in the air as safely as it will travel the roads, John E. Longenecker, of Lititz, Pa., has built a model of his proposed machine, shown below.

On a standard automobile he has mounted airplane wings. The Curtiss biplane type, arranged so that they will fold when the machine passes along narrow roads.

An ordinary airplane propeller is mounted in front of the radiator and is driven by belt and pulley from the front of the crankshaft. The transmission mechanism is such that power from the engine can be made to drive either the rear wheels or the propeller.



How wings fold back for road travel



## An Electric Flashlight without a Battery

A SMALL electric flashlight that is said to require no battery, is lighted by hand operation of a spring lever on the



Lever runs a magnet

side. It is designed for sportsmen, campers, motorists and watchmen, and for home use. It weighs only 12 ounces and is less than five inches long, fitting easily into the pocket. Since there is no battery to deteriorate, it requires no re-charge.

Pressure of the fingers on a lever spins a magnet within, generating electricity. The spring returns the lever to another position.

The case is said to be waterproof so that it cannot tarnish or rust.

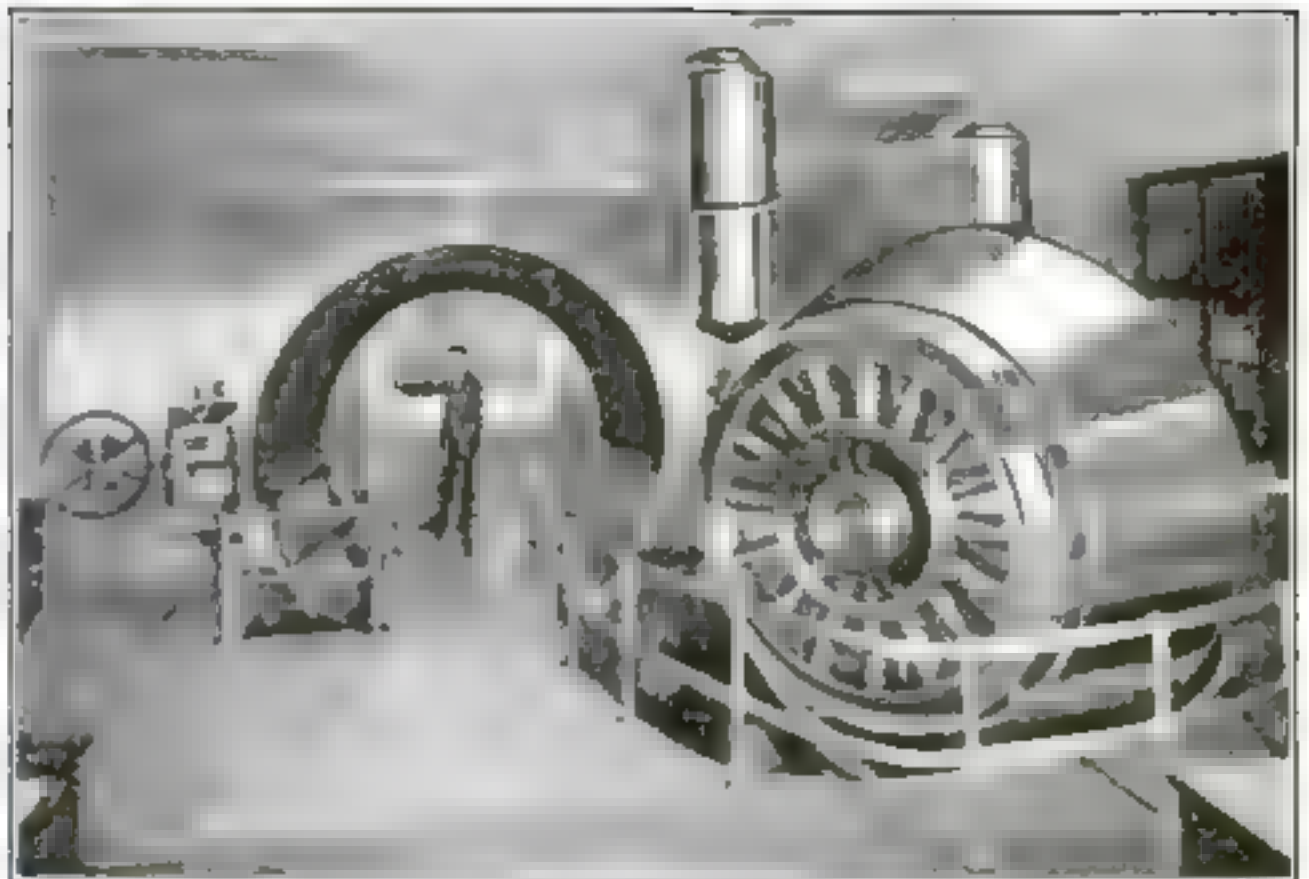
## Safety Goggles Attached to Eyeglass Rims



THE machinist whose eyes require glasses and whose job requires goggles for safety usually finds himself between disagreeable alternatives. Ordinary goggles cannot be worn satisfactorily with glasses. So either he must forego safety for clear vision, or he must forego clear vision for safety. The latter choice often is impossible.

The recently patented type of goggles shown above now permits him to use glasses and goggles simultaneously. Each glass is separate and snaps on the frames of standardized 1 9/16-inch spectacles. The attachment is effected by a little clip on the inside of the goggle cup. This clip is said to hold with a bulldog grip, fastening the goggles securely.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.



## Largest Bank Vault Door Four Feet Thick

SAID to be larger than any other door of its kind in the world, a giant bank vault door four feet thick, made of solid steel, recently has been installed in Cleveland, Ohio.

The total weight of the entrance is 195 tons. Weight of single stone on the door

is 40,765 pounds, exclusive of bolts. The outside diameter of the door is 124 inches and the inside diameter 90 inches.

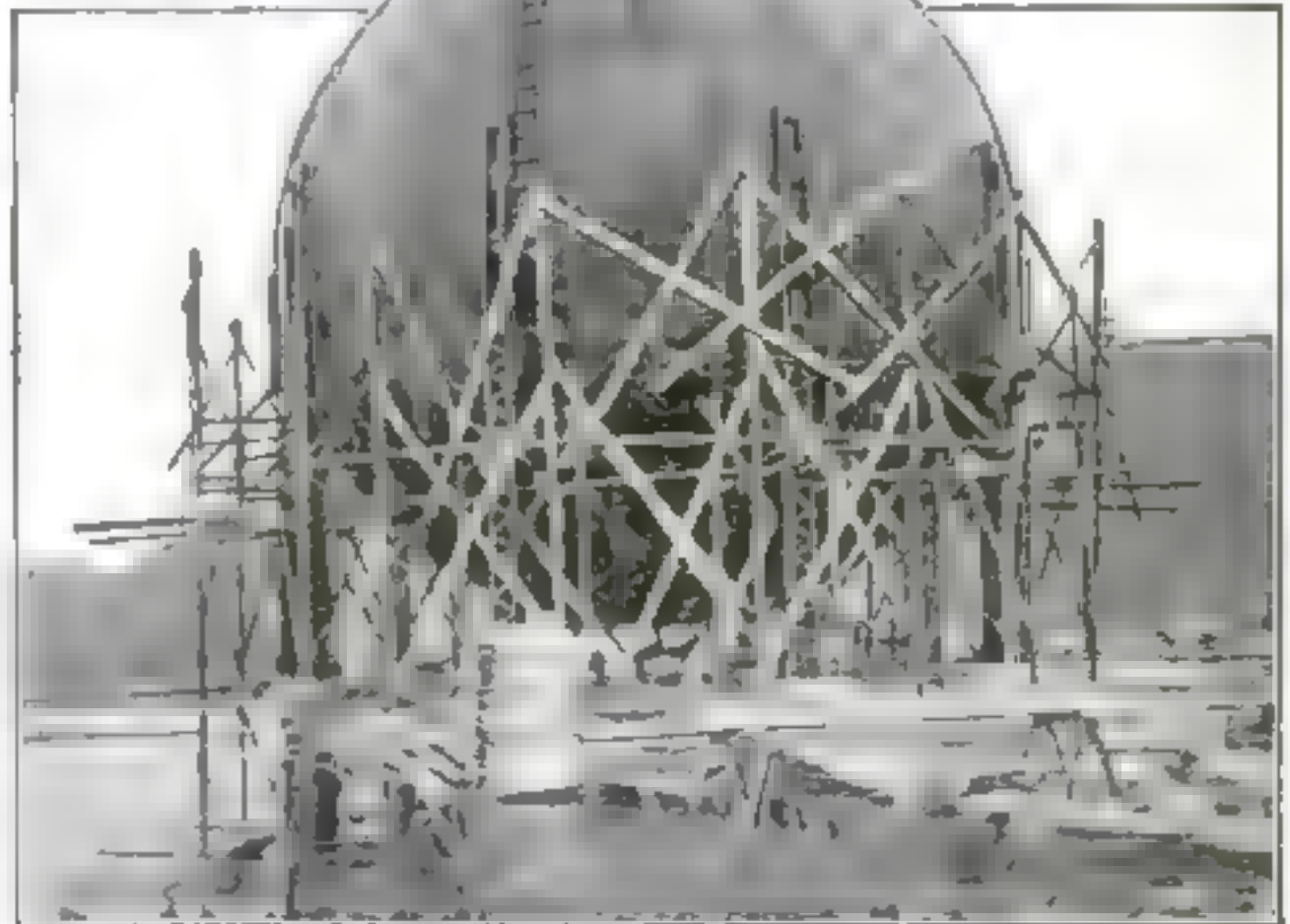
So delicately adjusted is the mechanism of the door on its roller bearing, and so accurately is it designed that it can be swung easily by pressure of the hand.

## Ball-Shaped Gasoline Tank to Reduce Waste

BUILT in the form of a giant metal globe, a new type of storage tank for gasoline is designed to eliminate the losses resulting from the partial evaporation of the fuel. Such wastage is said to be unavoidable where the ordinary cylindrical tanks are used. Evaporation by removing the most volatile part of the gasoline, degrades it. Where large quantities of gasoline are stored over a period of months, the total loss in evaporation is estimated at 10 per cent of the fuel.

The new tank is constructed on the theory that such a shape distributes internal pressure most evenly, variations in pressure being the most potent cause of evaporation. In the ordinary closed cylinder, the stresses due to pressure on the bottom are duplicated on the top, giving an end-to-end stress double the circular stress.

This huge gasoline globe is 50 feet in diameter, weighs 140 tons and contains 1250 tons of the fuel. It is built of steel and its seams are caulked.



The huge globe-shaped gasoline tank built of steel, nearing completion



# Mechanical Hands to Make

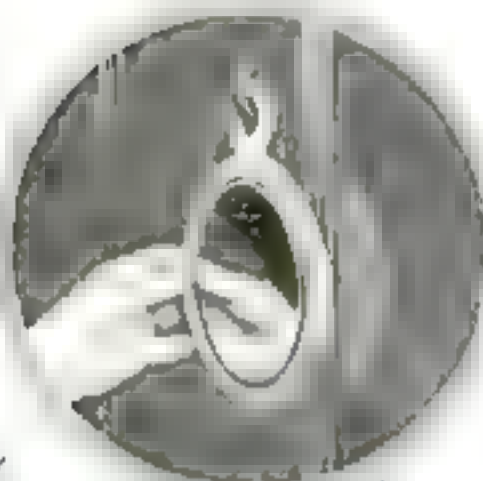


15110

1. This is a simple hot water heater. It is made of thin metal plate. It is placed in a hot water tank. The energy of heating is transferred



15712  
All sorts of things when a small amount of paper is placed in the flowing point. The heat is immediately a hot point rises with the water. The water is wound by hand.



2. A rubber vacuum is used for heating. It is made of rubber and is used to support the water. It is 20 inches in diameter and is of solid rubber. It does not injure the surface.

3. A simple type of heater. It is made of metal and is used for heating. It is 10 inches in diameter and is of solid metal. It does not injure the surface.



4. Six points of the heat of the water. It is made of metal and is used for heating. It is 10 inches in diameter and is of solid metal. It does not injure the surface.

5. Dough will not stick to the surface. It is heated when this knife is pulled. It is made of metal and is used for heating. It is 10 inches in diameter and is of solid metal. It does not injure the surface.

6. Only one hand is required to operate the heater. The heater is made of metal and is used for heating. It is 10 inches in diameter and is of solid metal. It does not injure the surface.



7. A sanitary mustard jar. Pressure on a finger gap ejects mustard in the quantity desired through a hard rubber stem. No spoon is required.



8. Two electrically heated rods over which the heat is transferred. It is made of metal and is used for heating. It is 10 inches in diameter and is of solid metal. It does not injure the surface.



9. Electricity from a light socket winds this clock. When it runs down, an automatic mechanism releases enough current to wind it up once more.



# Light Work for Housewives



X Putting an idea against the baseboard in a room with carpeting is a simple scheme to protect the problems of accessible room where footwear can be stored undamaged



X Heat in this new electric cooker is controlled automatically. All steam from cooking food is caught and condensed in the dome-shaped top



X A drying rack such as this hastens the drying of shoes. Surprisingly, the rack is made of wire and the shoes are hung by the laces. The rack is made of various sizes are provided



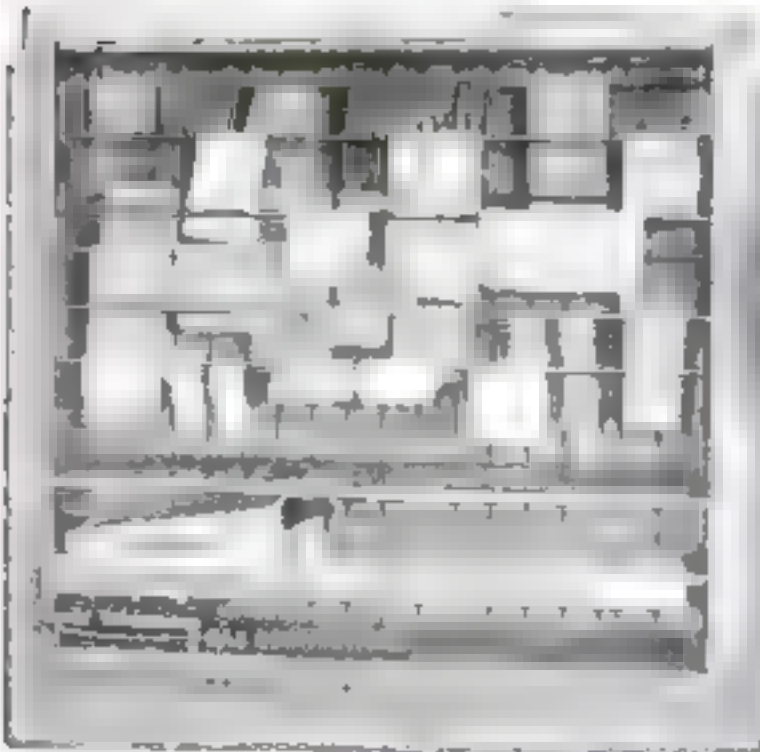
A midget electric heater that can be hung by a book wherever a wall plug is available, is handy for such purposes as drying a few clothes as well as for warming a spare room



To protect the new fabrics, these wooden safety tongs will lift clothes from the tub of scalding water or feed clothes to the wringer



A broom of any size fits into this holder consisting of a metal shoulder opposite which is a pivoted wooden block with a point that pinches the broom handle as the weight of the broom pulls downward



X This compact gas-heated clothes dryer is said to insure against the escape of fumes and to require no chimney connection



X Threading a needle is simplified by a device with a tiny notch that is thrust through the eye. The thread then is looped into the notch and drawn through the eye of the needle



X The invention of a combination electric and coal range assures the housewife a cool kitchen in summer and a warm one in winter





## Residence District Invaded by a Coal Mine

WITH dynamite, steam shovels, and locomotives, a coal company is following a rich vein of coal, only 10 feet below ground level, into the residence district of South Scranton, Pa.

A straggling ugly excavation gnaws to the very back stairs of the houses. And,

despite repeated and violent protests from property owners to state and federal authorities, the mining operations continue.

For some years it has been known that Scranton is built upon ground which is rich in coal deposits.

## Heated Box Is Substituted for Bedclothing



How the lighted box covers sleeper

REPLACING sheets, blankets, and quilts with a box open at each end and heated by four 40-watt lamps, Milton Fairchild, of Washington, D. C., believes he has rediscovered one of the hygienic principles which enabled primitive man to be rugged without doctors.

Air holes in the box supplement the ventilation afforded by the open ends. The sleeper's head remains outside. A blanket draped from the upper end of the box to his shoulders keeps the room in the darkness necessary to prompt and restful sleep.

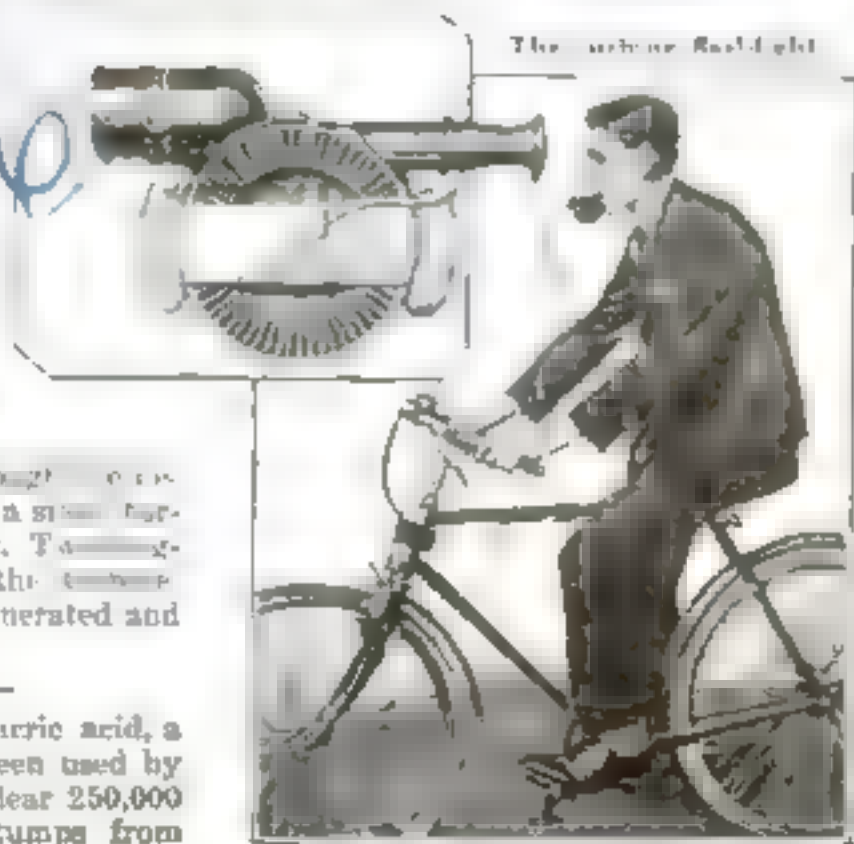
The lights supply warmth and, the inventor believes, many of the therapeutic values of sunlight. He is convinced that many ills are due to heavy bedding.

## Electric Flashlight Blown like a Whistle

THIS electric flashlight never will go dark because of an exhausted battery. It hasn't any battery. The user lights it by blowing through a mouthpiece. The inventor claims it cannot deteriorate by use, a feature making it a valuable convenience about the home. Often when a flashlight is needed most, it is found to be dead.

The wind current sent through the device by the blowing revolves a small turbine that generates electricity. Two magnets, one on each side of the turbine, gather the electricity thus generated and it is carried to the lamp.

ABOUT 7,500,000 pounds of picric acid, a surplus war explosive, has been used by farmers in this country to clear 250,000 acres of land and clear stumps from 86,000 acres in cultivation.



How the light is used by a cyclist

## Home Stepladder Designed for Sure Footing

THE stepladder commonly used about the house for such tasks as putting up window screens, hanging pictures, and painting window frames has been the cause of many a bad spill because of its uncertain support.

To insure against the possibility of such accident, a Chicago inventor has devised a ladder that he claims gives sure support because of the unusually wide spread of the legs and a double bracing arrangement, preventing tipping or uneven balance.

In addition, the ladder is provided with two extra steps at the top, affording adequate footing and greater assurance of security for the user.



The safety ladder, showing wide steps

## Iron Rust Costs Nation Billions Each Year

RUSTING of iron and steel costs the United States about \$3,000,000,000 a year, according to a report recently made by J. Vipond Davies, president of the United Engineering Society, based on researches extending over a period of 12 years.

Investigations revealed that sea water, water in alkaline coils, or water percolating through "fills" containing some kind of chemical wastes are the most common assailants of iron. They are discovered in the piping of water and sewage systems, tunnel linings, and similar structures.

Certain kinds of soil and water also act upon cast iron, slowly softening the metal until it can be cut with a penknife. Strange to say, iron thus softened becomes hard again when exposed to the air.



## Game Scoring Simplified by Scientific Method

**S**CORING a game becomes a sort of pleasure with an ingenious set of counters recently devised. At a glance, the scorer knows just how many counters of each color each player has, and how many of each color remain undistributed in the box.

Similarly, the player knows from a glance at his rack of counters how many of each color he has left. The rods prevent his stack from being knocked over.

Each rack has four rods, and each rod is graduated so that a number, indicating how many counters remain, always is visible just above the top chip. Each rack has a separate letter. In addition, there is a counting board, with letters corresponding to those on the racks and with holes in which pegs are inserted to indicate the number of counters issued each player.



The counter racks and counting board

## Wood Blocks Shaped to the Hand for Penholders

**T**HE ordinary penholder is a needlessly uncomfortable device, according to Paul Vosburg, a German inventor, who has contrived various new and shapes of wood blocks for the same purpose. These are short and thick, with indentations to fit the fingers and palm of the hand. The pen points are inserted in the back in the same manner that they are fitted into the ordinary penholder.

"Writer's cramp" is said not to afflict any one who uses these blocks faithfully.



Writing with wood block penholder



Norbert Casteret, young French archaeologist and explorer, standing in a cave in the Pyrenees. At the right is a cavern now

## Swimmer Finds Art and Writing of Cavemen

**I**N A 1300-foot cavern at the heart of a high, wooded loothill of the Pyrenees, Norbert Casteret, a young French archaeologist, of Toulouse University, recently found what are perhaps the most remarkable specimens of prehistoric art ever uncovered, estimated to be 10,000 years old.

A subterranean stream flows through the cave, winding through narrow and passages that man had never known of the hill. In many places the road the cave dips down into the water, forming a barrier that for centuries has guarded its prehistoric secrets from the curiosity of science. To ascertain as to how long these submerged stretches were, no one ever had had the courage to swim through them.

M. Casteret, one of the ablest swimmers in France, determined to undertake the submarine journey. Carrying a candle and matches in a rubber case, he plunged into the watery cavern, diving deep where the rocky roof descended below the waterline.

After swimming nearly a mile he reached a dry gallery about 250 feet long.



On the walls were engravings, made by flint instruments, of prehistoric animals—stags, mammoths, reindeer and wild horses. Also there were clay statues of animals, a large one of a bear and some 20 smaller ones, mostly of horses, badly mutilated by the drip of water from overhead.

A clay figure of half of a woman's body and some statues of tigers were found near by. Crude mural engravings, finger-prints, the claw marks of bears and mysterious red ochre symbols marked the walls—prehistoric records of incalculable value.

## Safety Razor Sharpener Operated by Crank

**T**URNING a small crank of this unusual safety razor sharpener automatically strokes back and forth the blade. The crank revolves in a housing designed at the same time brings one edge of the blade in contact with a stone the other. Thus, at every second turn of the crank the blade is completely swung around and turned.



At every second turn of the crank the blade is reversed as shown above





## Electric Locomotive Victor in "Tug-of-War"

**I**N A "tug-of-war" between an electric locomotive and a steam locomotive, during a recent test by the General Electric Company at Erie, Pa., the electric had its way, pulling backward its unwilling antagonist, throttle open for full speed ahead, for a distance of half a mile.

They were fit rivals. The electric victor is perhaps the most powerful of its kind ever built, and its steam opponent is one of the New York Central's mightiest. Picked crews directed them.

The steam locomotive was allowed to start before the electric's engineer touched his power lever. Almost immediately after he did so, the pair came to a slow stop. Then, straining in protest at every joint, the humiliated steam giant began to

move backward, pulled by its smaller adversary.

A valuable feature of this latest of electric locomotives, built for the Mexican Railway Co., Ltd., is its ability to generate power and feed it to the power line when it is running downhill. This feature also brakes the train.

This was demonstrated strikingly a few moments after the tug-of-war, when the steam locomotive was allowed to pull the electric one, the latter having its regeneration equipment ready. The pull corresponded to the impetus of a down grade and caused the electric locomotive to feed back into the power line a good part of the energy created by the steam engine's pull.

## Ride Side by Side on Odd Tandem Bicycle

**M**OUNTING this unusual two-seated bicycle is the hardest part of riding it. But, once the riders are up side by side, they are driven by four wheels, resulting in greater speed and increasing resistance with the ordinary bicycle.

Balancing is said to be no more difficult than with the old-style front and rear seat tandem.



Riding two abreast on the bicycle



## He Counts Dust Particles in the Atmosphere

**C**OLLECTING and counting dust particles from the east for the United States Weather Bureau is the daily specialty of J. A. M. Flann, government scientist. His instrument, shown above, also has been used on airplane flights to determine the dust content of air at various altitudes.

Particles captured vary in diameter from .0002 mm., a size barely discernible under the microscope, to .0015 mm.

## Frog Carries Its Young

**A** FROG of the Andes Mountains that carries its helpless young in a pouch on its back, Indian fashion, was discovered by Dr. C. Kingsley Noble, of the American Museum of Natural History during a trip of scientific exploration to South America. How the pouch is formed is a mystery, but there the little tadpoles dwell until ready to battle with life.

## Odd Land Boat Rowed by Oarlike Levers

**P**ROPELLED by two oarlike hand levers, and guided by a steering wheel at the rear that controls a single front wheel, an odd land rowboat is said to move at a speed considerably faster than a walk.

The two levers are geared to two rear wheels. A single pull on both levers is said to propel the car the distance of several strides.



"Rowing" the land boat with levers

## Electric Barbecue Cooks 2000 Pounds of Meat

**E**LECTRICITY cooked four 500-pound steers for crowds that attended an old-time barbecue at the annual Ephrata Roundup, at Ephrata, Washington, recently.

In an open pit 32 feet long were suspended 12 heating elements, each of three kilowatts capacity. About 180 feet of iron wire was required for each element. Sheet iron deflectors were installed. Bars to hold the meat were placed 18 inches above the deflectors.



Barbecuing steer meat by electricity





### Thirty-Year-Old Engine Holds Speed Record

OLD "999" queen of locomotives and holder of the world's speed record for her kind, had her moment of glory recently at the railroad exposition in Grand Central Terminal, New York City. A. H. Smith, once her proud engineer, now president of the New York Central lines, is shown above at her throttle.

The old steam queen was placed in service in 1869, and for years she pulled the fastest State-labeled, the fastest New York Central train, exactly on schedule. One day she was given full steam and a wide-open throttle. She responded with 112½ miles an hour, a record. It has stood since then. She was retired some years ago.

### Giant Organ Pipe Weighs More than a Ton

AN ORGAN pipe weighing more than a ton was installed recently in the instrument being built in Liverpool Cathedral, England. The pipe is 33 feet long and three feet in diameter. The completed instrument will be one of the largest in the country.



Workmen moving the giant organ pipe

### Recent Publications

A résumé of new books on science and invention

*Wireless of Today*, by Charles R. Gibson, F.R.S.E., and W. B. Cole, A.M., I.E.E. A non-technical explanation of the principles upon which wireless works and a description of the growth of wireless telephony and telegraphy from their inception until today. Illustrated. J. B. Lippincott & Co.

*Personality of Plants*, by Royal Dixon and Franklyn E. Fitch. A popular botanical work, describing the wonders of the plant world in terms that express an analogy in human activities. Illustrated. Boullion-Biggs.

*Everyone's Book of the Weather*, by A. Francon Wilhama. A concise guide for the amateur weather prophet. Illustrated. The Macmillan Company.

*Weather Proverbs and Paradoxes*, by William J. Humphreys, Ph.D., of the United States Weather Bureau. Ingenious application of the well-known weather adages and saws to scientific forecasting. Illustrated. Williams & Wilkins Company.

*Henley's 325 Radio Circuit Designs*, Written and edited by a large staff of radio experts. A handbook for the radio experimenter. Illustrated. Henley Publishing Company.

*Science and Human Affairs*, by Winton C. Curtis, professor of zoology, University of Missouri. A comprehensive exposition of the humanistic aspects of the natural sciences. Illustrated. Harcourt, Brace & Co.

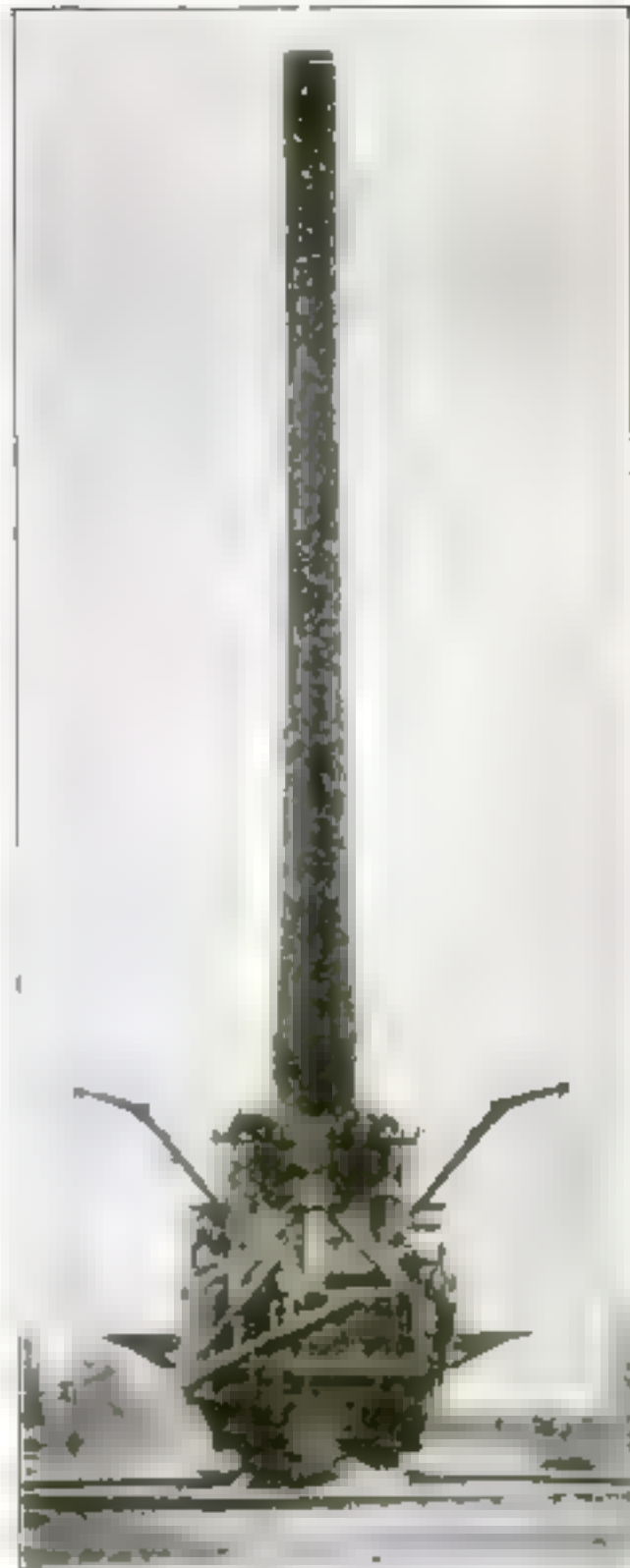
*The Atom and the Bohr Theory of Its Structure*, by H. A. Kramers, University of Copenhagen, and Helge Holst, Royal Technical College of Copenhagen, with a foreword by Sir Ernest Rutherford. Illustrated. Gylndendal (London).

### Famous Pianist Invents Recording Mechanism



A VEIN of inventive genius accompanies the artistic talent of Josef Hofmann, the noted pianist. This genius he has directed successfully at the problem of recording music on reproduction rolls.

The invention with which he is pictured above records the delicate touch of a pianist's fingers with such unerring fidelity that, it is said, no hand corrections on the master roll are necessary. Such hand corrections always have been costly, sometimes almost prohibitively so, and always have fallen short of precise faithfulness to the original.



### Uncle Sam's Greatest Gun Shoots 23 Miles

A MONSTER cannon, capable of hurling a 1560-pound projectile 23 miles, has been developed by the U. S. Ordnance Department. The monster Krupp gun that bombarded Paris during the Great War fired farther, but its shells were much smaller.

However, the new American gun, 14 inches and of 50 caliber, can be mounted on railway carriages. This mobility makes it far more deadly for most practical military purposes.

The great gun is shown elevated at an angle of 50 degrees. High elevations are necessary in firing such weapons because the trajectory of a projectile is an arc, whose center is high.

### Red Men Prefer Red Color

THE red man's fondness for color is well known, but it has remained for Dr. T. R. Garth, of the University of Denver, to ascertain scientifically the color preferences of Indians in the Southwest.

Full-blood Indians prefer red to all other colors, then blue, violet, yellow, and white in the order named. White men, living in the same social and educational environment, preferred blue, then green, and then red.



# Attacks Tuberculosis by Uncovering Hidden Germs



Dr. W. Fernet, founder of the Saarbrücken Micro-Biology, at Saarbrücken, Germany, has launched a new attack on tuberculosis.



Above: Tapping drops of blood from a boy's ear lobe for the Fernet test for tuberculosis. At left: Making the blood test.

**STRIPPING** tuberculosis germs of protective coatings of fat may prove the long-sought way to conquer the "white plague," according to Dr. W. Fernet, director of the Micro-Biological Institute at Saarbrücken, Germany, whose researches the medical world is following closely.

Doctor Fernet was started on his investigations by the long-known paradox that, although 90 per cent of all persons at some time are infected with tuberculosis, only one tenth of these die of the disease. In fact, most infected persons never know they have contracted it. Obviously Nature has immunized them successfully after the disease has attacked them.

Doctor Fernet sought the secret of this

immunization. He concluded after considerable research that the destructive objects called tubercles actually were the disease germs wrapped in a thick resisting layer of fat.

With ether vapor and specially devised apparatus, he succeeded in exposing the naked germ. With this he was able to get reactions and obtain a diagnosis in the early stages of the disease, whereas in most cases the victims are necessarily ignorant of their condition, simply because the fat-encased germs do not respond to early diagnosis tests.

Now that he has naked germs to work with, Doctor Fernet says he can obtain reactions to various tests more easily and decisively.

## Sunflower Plant Saved by Hairpin Surgery

**BY PLANT** surgery of a remarkable sort, accomplished with a little raw egg and a hairpin, Mrs. Zaida Edwards, of Omaha, Neb., has succeeded in trans-



Mrs. Edwards and her giant sunflower.

forming a stunted, dying sunflower plant into a healthy giant—one of the largest plants of its kind on record in the United States.

The story begins when it was only two feet tall, and barely alive. A worm, snugly ensconced in a large hole near its top, was sapping its life. A deli hairpin dislodged the worm and cleaned the wound. Then the surgeon noticed that flies and ants were investigating the cavity. So she filled it with a little raw egg.

Within less than 24 hours, she declares, the plant had grown two feet and its wound had healed. With astonishing rapidity, it continued to ascend. Today it stands nine feet high and its flower measures seven inches across.

**BUTTER** and butter substitutes are easily distinguished by a simple test. Hold a spoonful over the teakettle spout or at some distance above a gas flame. If the contents become a sort of foam, you have butter. Substitutes melt.



## Powerful Microscope Is Five Feet Long

**WHAT** is said to be one of the world's largest microscopes—five feet long—has been completed by W. J. Reagan, of Los Angeles, Calif., who spent more than a year in calculation and perfecting its intricate design. Its powerful eye is claimed to reveal amazing detail in the minutest objects.

## Synthetic Wood Alcohol

**WOOD** alcohol, of which the United States produces 17,000,000 gallons a year, requiring the consumption of more than 2,000,000 cords of hard wood, can be made from natural gas, chlorine, and lime.

## "Moonlight Movies" Filmed in the Daytime

**A PERFECT** illusion of moonlight is claimed for "night" movie films taken in the daytime through a light filter just invented by Virgil Miller, a camera man at Universal City, Calif. Three pieces of glass in this contrivance are said to filter from light entering the lens all but the rays that are found in moonlight.

Strange effects result from its action. Red, which ordinarily photographs as black, appears white. Blue, which is white on the usual film, tends to black. A blue sky becomes black.



Virgil Miller with his moonlight camera.



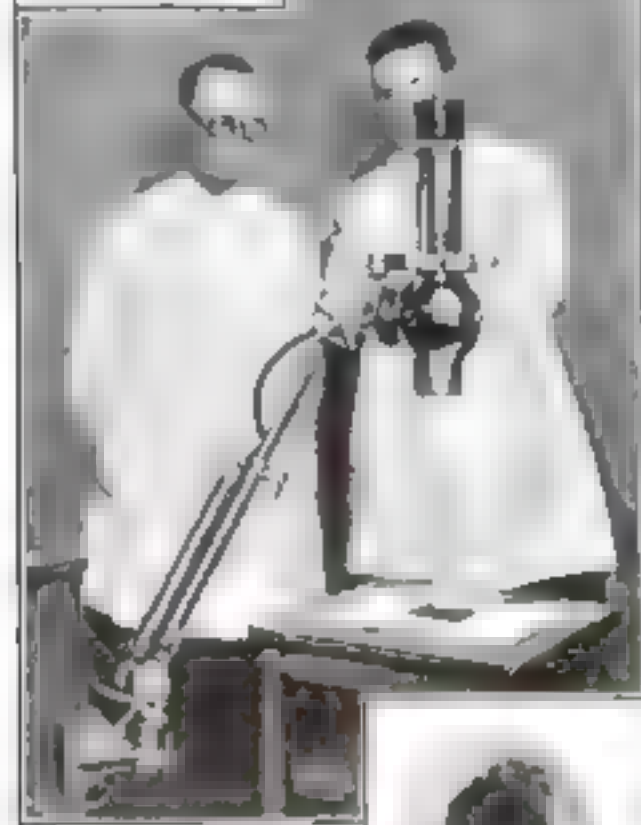
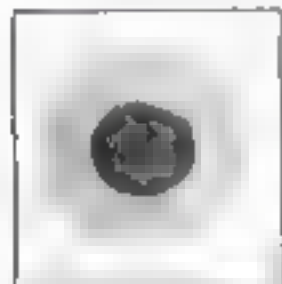
## Dubbed Golf Shots Laid to Imperfect Balls

**C**ONVINCED that many a disastrous golf stroke, often one crucial in a championship tournament, should be held against the ball and not the golfer, Dr. B. L. Taylor, a Washington, D. C., dentist, attacked 10 of the best-known brands with a vise, a mercury bath, and his dental X-ray.

Only one ball of the 10 was found by the X-ray to have a perfect, round core, he reported. Yet a ball with an irregular core will not travel true to line. As soon as its velocity drops, it will tend to roll toward the side with the most weight.

The same ball was the only one of the 10 to pass the mercury test successfully—the only one that did not turn over or shift to accommodate uneven weight, when floated in the liquid metal.

Remedial balance was attempted in several of the balls by a hypodermic injection, but the results were not wholly satisfactory. Moreover, the very well might cause a shifting of this injected material.



A golf ball under the X-ray, with photo showing irregular core.

Using the jaws of a vise as a caliper gage to determine exterior roundness, Doctor Taylor found again that only the one ball of the 10 was perfect. Evidently failure to achieve roundness of core had doomed the remaining balls to surface irregularity, in spite of all remedial measures.

The purpose of these researches is to establish a standardized ball for golf tournaments.

## The Tungsten Filament

**T**UNGSTEN filaments used in electric light bulbs and vacuum tubes are coils of almost invisible wire only one thousandth of an inch thick, wound on a core of steel or brass only four one-thousandths of an inch through.



Feeding coffee to a rabbit in laboratory tests at the Massachusetts Institute of Technology.

## Coffee Not Injurious, Investigators Find

**C**OFFEE has been tried and acquitted by the Massachusetts Institute of Technology, under the direction of Prof. Samuel C. Prescott, of the Department of Biology and Public Health. The verdict undoubtedly will be a popular one for Americans who yearly consume nearly 14 pounds of coffee annually per capita, or a total of 1,398,176,000 pounds.

The investigators, in a comprehensive laboratory research, subjected the chemistry, microscopic structure, and micro-

organisms of coffee to painstaking analysis. Finally, coffee was fed to rabbits to discover the effect upon living creatures.

Following are the conclusions to which these experiments led the investigators. Coffee has a remarkably stimulating and fatigue-relieving effect, mildly increasing heart action and one's ability to work, and aiding concentration. Unlike other stimulants, it produces no subsequent depression and does not draw upon the body's physical reserves.

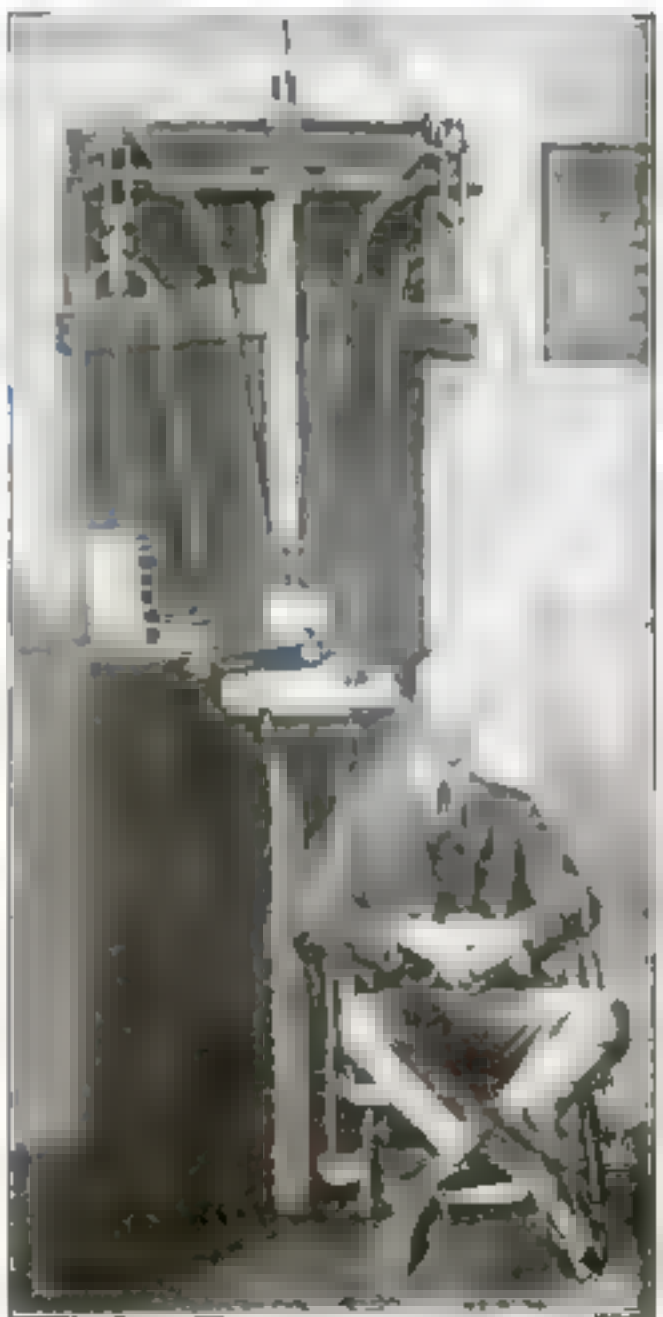
## Your Body Is Losing Weight Every Second

**F**IVE minutes from now, unless you eat or drink in the meantime, you will weigh less. In fact, you will weigh less a minute from now, because the body constantly is losing weight by evaporation and by loss of carbon. This carbon is obtained from your food and is lost by breathing, which combines the food with oxygen, forming carbon dioxide.

But, exceeding dynamometer scales, elevated recently by the Carnegie Institution, are now being used to measure the sum of these losses. In one of the tests a man seated on the chair of the scales lost so rapidly that small weights had to be added steadily to keep the balance even. Most of this loss is by perspiration, which usually is not noticed, except on hot or humid days or after unusual physical exertion. The stouter one is, the more weight is lost by perspiration.

Numerous interesting facts have been revealed by the new scales. The more clothing a person wears, the more rapidly does he lose weight, because of increased perspiration. A football player lost 14 pounds in a game lasting 70 minutes. A marathon runner lost 3½ pounds in a three-hour race. A varsity oarsman lost 5¼ pounds in a four-mile race lasting 22 minutes. In such extreme exertions, of course, a small part of the loss consists of burned tissue. The remaining loss is through breathing and perspiration.

The scales also are finding invaluable use in hospitals as a means of measuring the activity of a patient's bodily proc-



Measuring the body's loss of weight.





## Electric Speed Giant Shipped to France

THE world's fastest electric locomotive, which won its title with a 145-mile speed in recent tests at Erie, Pa., has forsaken its native land. It was loaded on a freighter recently, consigned to the Paris-

Orleans Railroad, in France, which is electrifying 1,000 miles of its lines.

The picture shows the locomotive in midair, as it was being slung aboard the vessel.

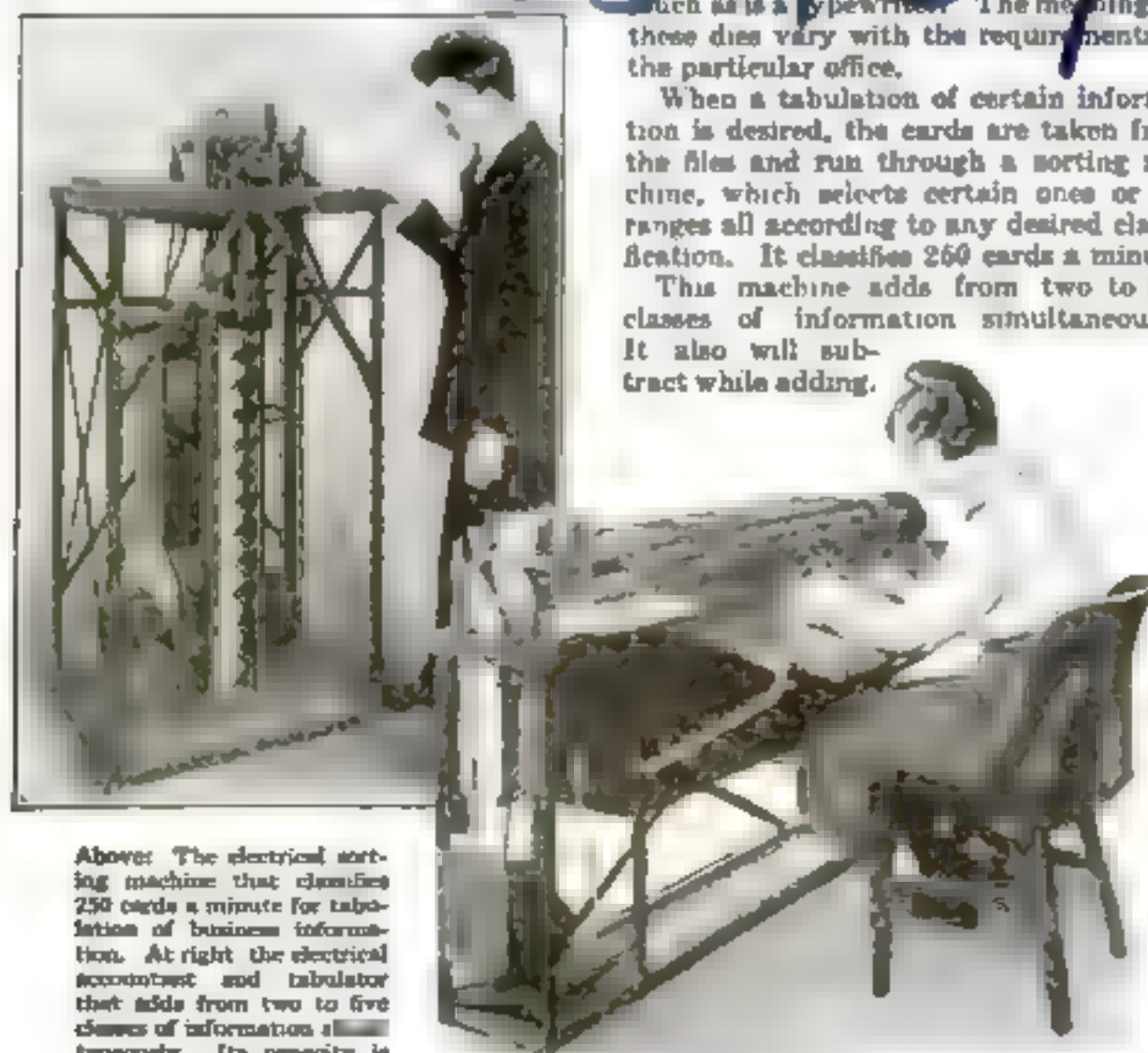
## Machine Performs the Work of Many Clerks

A MECHANICAL accountant and tabulator of amazing versatility driven by electricity, now performing the work of a small staff of clerks and book-

keepers in a number of Western offices. Cards printed according to the information to be tabulated are punched by a special machine, with 12 dies, operated much as is a typewriter. The meanings of these dies vary with the requirements of the particular office.

When a tabulation of certain information is desired, the cards are taken from the files and run through a sorting machine, which selects certain ones or arranges all according to any desired classification. It classifies 250 cards a minute.

This machine adds from two to five classes of information simultaneously. It also will subtract while adding.



Above: The electrical sorting machine that classifies 250 cards a minute for tabulation of business information. At right the electrical accountant and tabulator that adds from two to five classes of information simultaneously. Its capacity is 750 additions a minute.

## New Twistless Blade for Insulated Screwdriver

MANY insulated screwdrivers develop a twisting blade after a few months of use. To obviate this, the inventor of a new type of tool has bent the shank of the



How blade is fastened to handle

For some time the handle of a screwdriver has been made of rubber. The idea of distributing the strain of twisting on the handle when it is turned under pressure.

The handle of the screwdriver is of rubber.

## Transparent Minnow Trap for Fishermen

A TRANSPARENT minnow trap, nearly a foot long yet weighing less than 1 1/4 pounds, is one of the new accessories for anglers.

It is cylindrical in shape, sheathed around with transparent material. A transparent opening near one end is just sufficient to admit a good sized minnow.

Boiling water flows out through a perforated galvanized iron plate at the



Pouring water from catch of minnows

funnel-shaped end of the trap. The trap stands on two pairs of wire legs and has a wire handle.

## Gelatin a Valuable Food

THE food value of gelatin is far greater than is realized generally, according to the announcement of chemists of the Mellon Institute of Industrial Research, University of Pittsburgh, who recently completed a scientific investigation of the subject.

The greatest benefit is derived, they say, when gelatin is combined with other foods such as cereals, bread, milk, eggs, and ice-cream.



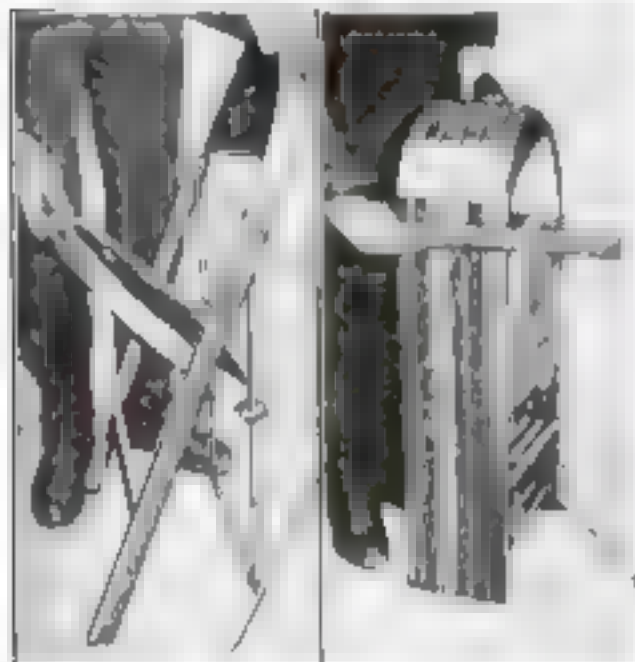
## Nine Collapsible Chairs to a Foot of Space

NINE of the newest type of collapsible chairs, when folded, would make a row less than a foot long. Each chair collapses to a thickness of one and a quarter inches.

These easily portable seats are especially adapted for conventions, banquets, lectures, dances, or for camping. A number of them can be carried conveniently on a motor camping trip.

The damage done to chairs by moving them frequently is said to have been reduced materially by the invention. They can be stored handily in halls in sufficient numbers to accommodate large crowds.

Although of solid construction, the seats are said to be surprisingly comfortable for folding chairs, each having an upholstered leather seat and a back rest of comfortable design, shown in the left-hand illustration below.



Six chairs, when collapsed, make a row seven and a half inches long, as shown.

## Our Bodies, like Engines, Must Be Cooled

IF IT were possible to inclose a man so that while he could breathe, no heat could escape from his body, he would die quickly.

Such is the announcement of Dr. T. H. Read, supervising mining engineer of the Department of the Interior, and F. C. Houghton of the American Society of Heating and Ventilating Engineers, who have completed an investigation of effects of heat on the body.

In a series of experiments it was found that a dry-bulb and wet-bulb temperature of 112.5° F. could be borne for only 35 minutes, even when the subject was at rest. A temperature of 100 degrees could be tolerated only 45 minutes.

"The human body, like any other internal combustion engine, must be cooled in order to function properly," says the report of the investigators. "Under ordinary circumstances the air surrounding people is enough cooler than themselves to permit the heat generated within the body to be given off without difficulty. At higher temperatures, or when the rate of work with its corresponding generation of heat is high, the body cannot throw off heat fast enough, so it begins to sweat. Evaporation of the sweat cools the body."



## Steam Excavator Turned into a Pile Driver

A DRAGLINE excavator was used recently to drive piles in the construction of the Black Street bridge, at Hamilton, Ohio. As many as 100 piles were sunk, spotted, and driven with an average penetration of 18 inches per 10-hour shift.

The pile-driver mechanism was attached to the hoist cable of the dragline so that it could be raised or lowered easily.



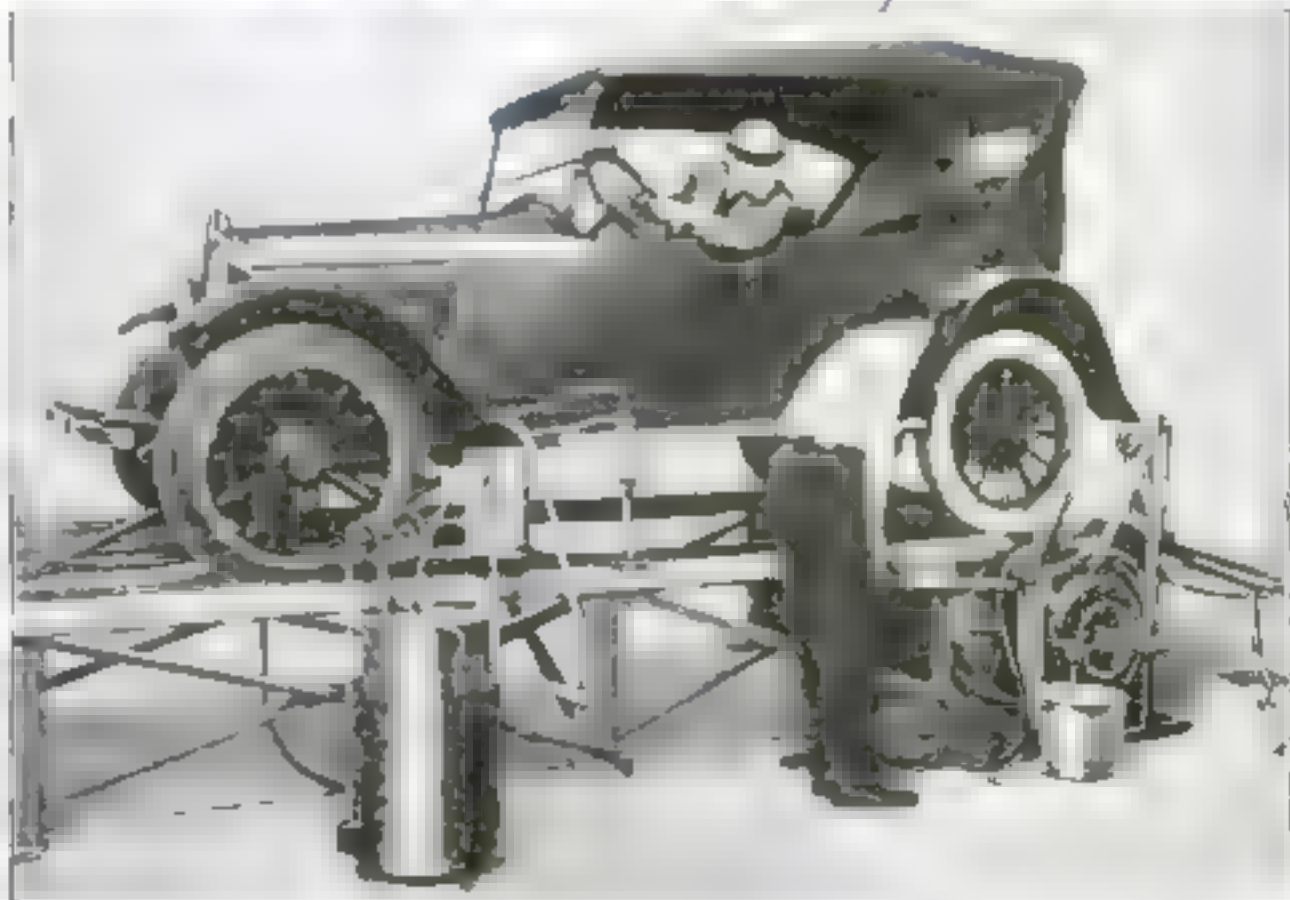
How the excavator was used to drive piles in building a bridge.

## Testing-Stand Diagnoses Automobile Ills

IF A MOTORIST is to keep his car in good condition and measures virtually all engine troubles in motor cars now is used.

It consists of a frame which supports the engine in a vertical position, and a spray valve which can be adjusted to spray oil on the engine.

It also carries a flowmeter to measure gasolene consumption; a special valve to measure the amount of leakage past the piston; a flowmeter to measure gasolene consumption; a special valve to measure the amount of leakage past the piston; a flowmeter to measure gasolene consumption; a special valve to measure the amount of leakage past the piston.



A car undergoing tests, showing instruments that detect and measure engine defects.



## The Man Who Sends Time Signals

**YOU** wherever you live in the United States—have heard him many a time over your radio set. He is Paul Sollenburger, of the United States Naval Observatory at Arlington Va. the man who sends out the twice daily time signals—at noon and at 10 P. M.

The sending apparatus of the Naval Observatory is one of the most powerful in the world. Frequently it is in touch with Cordova, Alaska, and sometimes even with Europe.

Many broadcast stations retransmit Sollenburger's signals on wave lengths within the range of the average receiver. Yet, because of the

speed of radio waves, you hear the signals almost simultaneously with their transmission from Arlington.



Paul Sollenburger, time signal operator at the Arlington station

### Powerful Receiver Carried on Hiker's Belt

**EQUIPPED** with this radio belt, the hiker can carry with him, through the woods and over hills, or in a camp, the voices of noted men, the symphonies of famous orchestras, and the story of the day's events.

The apparatus, devised by Henry Farkouh, of New York City, is a powerful four-tube receiver, the parts of which are mounted on a narrow, shelflike baseboard fastened about the waist.

The set is said to have sufficient sensitivity to operate a loudspeaker. It is claimed that broadcasting stations a thousand miles away can be heard with it.

RADIO dances have become one of the most popular forms of entertainment in the Yukon during the past winter. Residents of Dawson and many a small settlement along the Yukon River are reported to have tripped the light fantastic to broadcast music played by the best orchestras in the United States.



### Changeable Rheostat

**A NEW** rheostat to fill the need for easy change from one resistance to another has been devised for those who like to use dry-cell and storage-battery tubes interchangeably. All that is necessary is to replace the resistance cartridge with another one of the required value.

Three standard cartridges of eight, 25, and 40 ohms are available to suit the requirements of various tubes and tube arrangements.

### New Variable Condenser for Finest Tuning

**IN TUNING** a radio receiver for the best results, it is desirable to have a variable condenser of the largest possible maximum capacity, in order to afford a

wide range of capacity between maximum and minimum capacities. Yet the fact that variable condensers come in fixed, standard sizes, makes fine reductions in capacity range impossible.

To overcome this difficulty, a new type of condenser is so constructed that any number of plates can be removed to lower the capacity range. The instrument finds its best use in experimental circuits, where the receiver must be adapted to widely varying conditions.



Variable condenser

### Have You Consulted the Family Radio Doctor?

**ONE** of the outgrowths of the rapid advance of radio is the Radio Doctors' Association, an organization of enthusiasts in the curing of radio ills. The president of the association is Dr. H. S. Lewis, F.R.C., builder of the first set capable of receiving the Government long-distance radiophone tests in 1912.

These physicians of ether waves serve radio manufacturers and fans.



Dr. H. S. Lewis, president of the Radio Doctors' Association

### Novel Type of Rheostat Is Easily Adjusted

**A NEW** form of variable rheostat in which the contact arm can be adjusted to any point on the resistance wire recently has been perfected by a manufacturer of radio devices.

The resistance wire is fitted in a helical groove on the cylindrical drum.

An unusual feature is the fact that the wire can be removed easily and another wire of a different resistance wound in its place. An adjustment takes up any slack.



Adjusting the rheostat





The home we chose—a sturdy Dutch colonial house of 11 large rooms, sleeping porch and bath. Floor plans are shown below.

# Adventures in Home Ownership

## Chapter I—We Hunt a Ready-Built House

By Phil M. Riley

*Noted American Authority on  
Architecture and Building*

TO MOST of us the fun of hunting a house we can call our own is like the fun of going fishing, of sitting by an open campfire, or of hiking through unfamiliar country. It seems to be born in our flesh. In my time I must have explored at least a thousand houses from garret to cellar. I have made the personal acquaintance of well-set-up houses, shabby houses, slovenly houses; houses whose four walls have held a lifetime of happiness and comfort, other houses that, like unfaithful friends, promised only disappointment and regret.

Yet even now the opportunity to "hunt a house"—to open new front doors and find the surprises that lie within—brings the same old instinctive thrill of discovery.

So it was when I heard the voice of Marion Hunter on the telephone.

"Believe it or not," she was saying, "Jim and I are in your town to get us a home of our own. We figure we've been long enough paying out hard-earned cash to landlords. Could you spare us enough time to guide us away from the pitfalls?"

Could I? If Marion Hunter

was still the same Marion who used to lead us kids over treacherous floor beams, planking and rafters in the old docks, this was to be a merry hunt.

"Come on," I told her, "I'll go with you. We'll be waiting for you with the car."

From the occasional news I had received, I surmised that they wanted a cottage or bungalow of six or seven rooms, sufficient for them and their two small children.

I found my guess was correct when Jim and Marion burst in upon me, uncereemoniously on a tide of bubbling excitement.

"Look here!" cried Marion almost before we could exchange greetings. She

was holding high a much crumpled sheet of paper. "I have a whole list of them all the way from \$7500 up. Pay your money and take your choice."

"Fine!" I replied. "That's forethought."

We picked the greatest house on the list and soon were on our way.

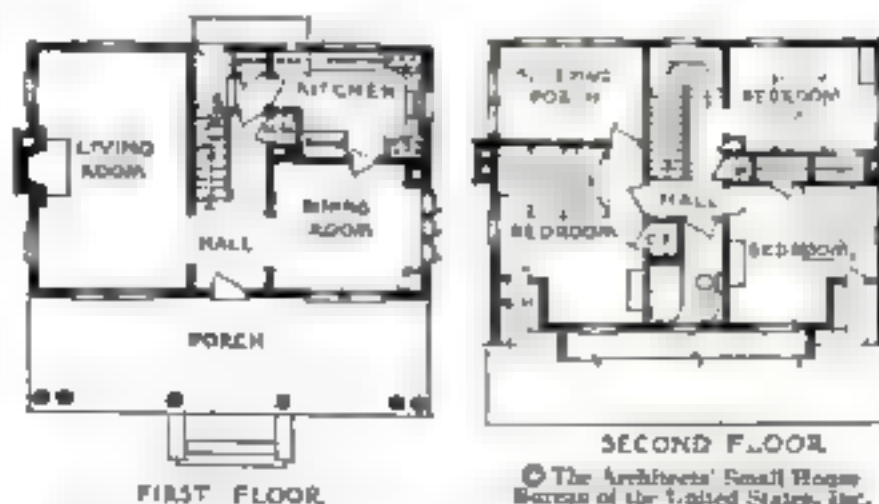
"Oooh! Look! Isn't it a little beauty?" Marion exclaimed as the car stopped before a newly built cottage of New England colonial design.

"It sure is," echoed Jim. There was a pleased, boyish gleam in his eyes.

And so it was. The whole exterior design of the house, with its clean white siding, its green shutters and green shingled roof, seemed to be arranged to

invite the home seeker. It was set upon a roomy lot, about 75 feet wide and 150 feet deep, in a newly developed and restricted residential section of the town, about 10 minutes' walk from a railway station. The street was paved. Cement sidewalks were in. A cement driveway led to a neat little one-car garage in the rear. Small shade trees and shrubbery had been planted. The setting seemed to be ideal.

But the pleasure of this first impression was eclipsed as we opened the front door and stepped into a small hall that led into a spacious living-room



Floor plans of the Dutch colonial house shown above. Cost between \$8000 and \$10,000, depending upon its locality.



extending the entire width of the house. On one side of the room two French doors opened to a large living porch. On the other side was a fireplace with a Colonial mantel.

Marion stood in the center of the room, speechless with delight.

"Oh, it's lovely," she gasped; "just what I've always wanted for, fireplace and everything." She was like a little girl playing with her first doll-house. "Look! The piano will just fit here, and the bookcase here"—skipping from one end of the room to the other—"and the grandfather chair here, and—"

She was visioning exactly how the room would look, dressed in its furnishings, while Jim stood by, smiling his pleasure, yet seeing little beyond the white plastered walls that he was scanning methodically.

"A breakfast nook?" Marion was dancing again. "I never dreamed we could have one! And a dear little entry with a door where the iceman can put the milk right into the house without ever coming in!"

It was the sort of kitchen to gladden any housewife's heart. But what caught my eye was the arrangement of the cupboards that formed a great long bar

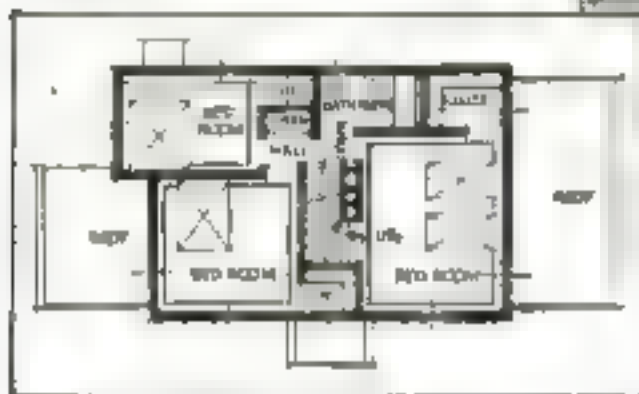
was a series of low cupboards for pots and pans. The entire arrangement resembled the old-time butler's pantry, even to the tall squawling arched faucets. What the builder's purpose could have been, I cannot say, unless it was to catch the eye of the uninitiated. Marion, however, was not one to be so enticed.

"This will never do!" was her comment. "Wooden drains, dark cupboards, bugs, mice, dirt." She shook her head sadly. "You just can't keep them fresh and clean. Why didn't that builder have sense enough just to put in a nice porcelain sink and forget about the other fixings? Maybe we can get him to do it for us."

We opened a door that gave entry from the kitchen to the cellar stairs. That cellar! Stagnant water from the last rain lay in small pools on the uneven



An unusually attractive home of New England colonial design, with six rooms and bath. This house we passed up simply because of its evident slovenly workmanship and poor materials.



SECOND FLOOR

"You've got the right idea, Marion," I told her, trying not to appear professional. "If every woman would think about the furniture and where she was going to put it, before buying a house, it would save a lot of grief later on."

Marion, absorbed in a survey of the fireplace, continued:

"Won't it be great, Jim, those cold winter evenings—"

"You see," interrupted Jim with a sly wink at me, "we've already bought this house—with the emphasis on the *see*. What I was interested in, though, was that big diagonal crack in the plaster above the door into the hall."

"Oh, is that all?" Marion exclaimed, with a sigh of relief. "Why, we can easily fix a crack like that with putty."

It evidently was time to assert myself as official adviser.

"Not so fast, young lady," I said. "You haven't begun yet to look at this house. Maybe we can fix that crack with putty. Maybe not. Some cracks are just cracks, you know. And others—well, they're holes that sometimes make all the difference between the house you don't want and one you do want."

"But," I added quickly as I saw a momentary look of apprehension on her face, "we'll find out all about that later. Let's move on and see the rest."

She soon forgot her fears as we crossed the hall into the cozy square dining-room with its built-in sideboard and china closet, its wide windows, and a door that gave access to another and smaller porch. Then on to the cheery white kitchen.

## A Handbook on Home Buying

BY ARRANGEMENT with the United States Department of Commerce, POPULAR SCIENCE MONTHLY is able to offer to its readers copies of the government booklet "How to Buy a Home," recently published under the supervision of Secretary Herbert Hoover.

This unusually comprehensive handbook prepared after years of research by John M. Gries and James S. Taylor, of the Division of Building and Housing, U. S. Bureau of Standards, answers the many questions that are likely to confront the prospective home owner and explains important safeguards in buying.

Copies of "How to Buy a Home" will be sent by the editor to our readers on request.

cabinet extending clear up to the ceiling. Each cupboard was fitted with glass doors. Beneath was a rather small enameled metal sink, bordered on each side by wooden drainboards extending in a counter effect the full length of the cabinet. Beneath the sink and boards



With extensive repairs this roomy old dwelling could be transformed into a light, airy and beautiful home. Yet the cost of improvements would eat up the price advantage.



FIRST FLOOR

cement floor. The cement walls were dark and spotted with moisture. The window sashes, too, were water logged.

"Not much of a place for a workbench or a laundry, I should say," Jim remarked.

"Yes, and you'd have to do the bailing act every time it rained," I added. "Look here."

I opened one of the windows and we looked out into the yard.

Not only was the grading higher than the base of the windows, but it sloped gently toward the house. It was easy to see what happened every time there was a rain. The cellar became a veritable reservoir. And to make matters worse, there was no floor drain. The flood was heightened, too, by the fact that there were neither gutters nor leaders to carry away the rain that poured from the roof.

"I'm afraid you'll have to be prepared for the worst," I warned. "I have seen many a cellar like this. In some cases the trouble has been remedied by regrading the whole yard, an expensive job. But here the damage goes further than that. If you examine closely, you'll find that the continual attack of water has caused the foundations to settle and crack. And this leads us back to the crack that Jim saw up in the living-room plaster—the one Marion wanted to putty. Did you notice that there were similar wide cracks in the dining-room and kitchen?"

"But what have they to do with the cellar?" Jim inquired.

(Continued on page 135)



# How To Find the Combination for Tuning Your Radio Set

By Jack Binns

America's Most Popular Writer  
on Radio

**H**OW can I get the best out of my receiver?

Every owner of a radio set asks himself that question, irrespective of the type of set he has, factory built or home constructed. To answer it, we must acknowledge first of all that all radio receivers come within the scope of two main classifications—those that regenerate, and those that suppress it. Next, we must determine which of these two classes applies to our own particular receiver. Then it will be an easy task to follow the cardinal points of tuning, which are:

## Rules of Tuning

1. Remember always that the tuning dials of your receiver are like the sensitive combination dial of a safe or bank vault. They require precise, careful manipulation. For every broadcasting station you wish to tune in there is a definite combination that will give the best results. It is an excellent plan, every time you bring in a new station, to keep a permanent record of the tuning combination that opened in to your reception. A suggestion for such a record appears on the following page.

2. Do not force your set—there is a limit beyond which it cannot go.

3. Do not let your set squeal, or you will waste precious energy and annoy your neighbors.

4. Do not twist the dials rapidly. They should be moved very slowly and very carefully.

5. In regenerative sets begin tuning for the station with regeneration at zero, and when the station is heard, increase regeneration until the signal is at its loudest.

6. Never increase the filament voltage of a tube above the value recommended by the manufacturer. Keep it below that point if possible. It is a matter of economy as well as efficiency. If in doubt, use a voltmeter across the terminals of the tube socket.

## Operating the Regenerative Receiver

With these points in mind let us consider the correct method of tuning a regenerative receiver. Whether the set is a single, double, or triple circuit type, the main principles will be the same.

The first thing to do, of course, is to turn on the filament rheostat. If you

have a small voltmeter handy, connect it across the two filament terminals, and turn the rheostat until the needle registers five volts, then leave the rheostat at that setting. On any other set the reading should be a voltage with the rating of the filament.

In a regenerative set the regeneration

control is in the form of a variable capacitor. If the signal strength does not increase as the coupling is increased, reverse the leads to the tickler

coil. It seems to be a general opinion that single-circuit regenerative receivers do not radiate and cause interference with other receiving sets in the neighborhood.

This is untrue. Double- and triple-circuit regenerative sets can be equally as annoying as the single-circuit type.

In tuning such circuits, it is best to keep the coupling between the primary and secondary coils as loose as possible until the station desired is heard. After that the coupling can be increased gradually, but in this case, of course, readjustments will be necessary in other parts of the set in order to clear up the signals.

## The Squeal Maker

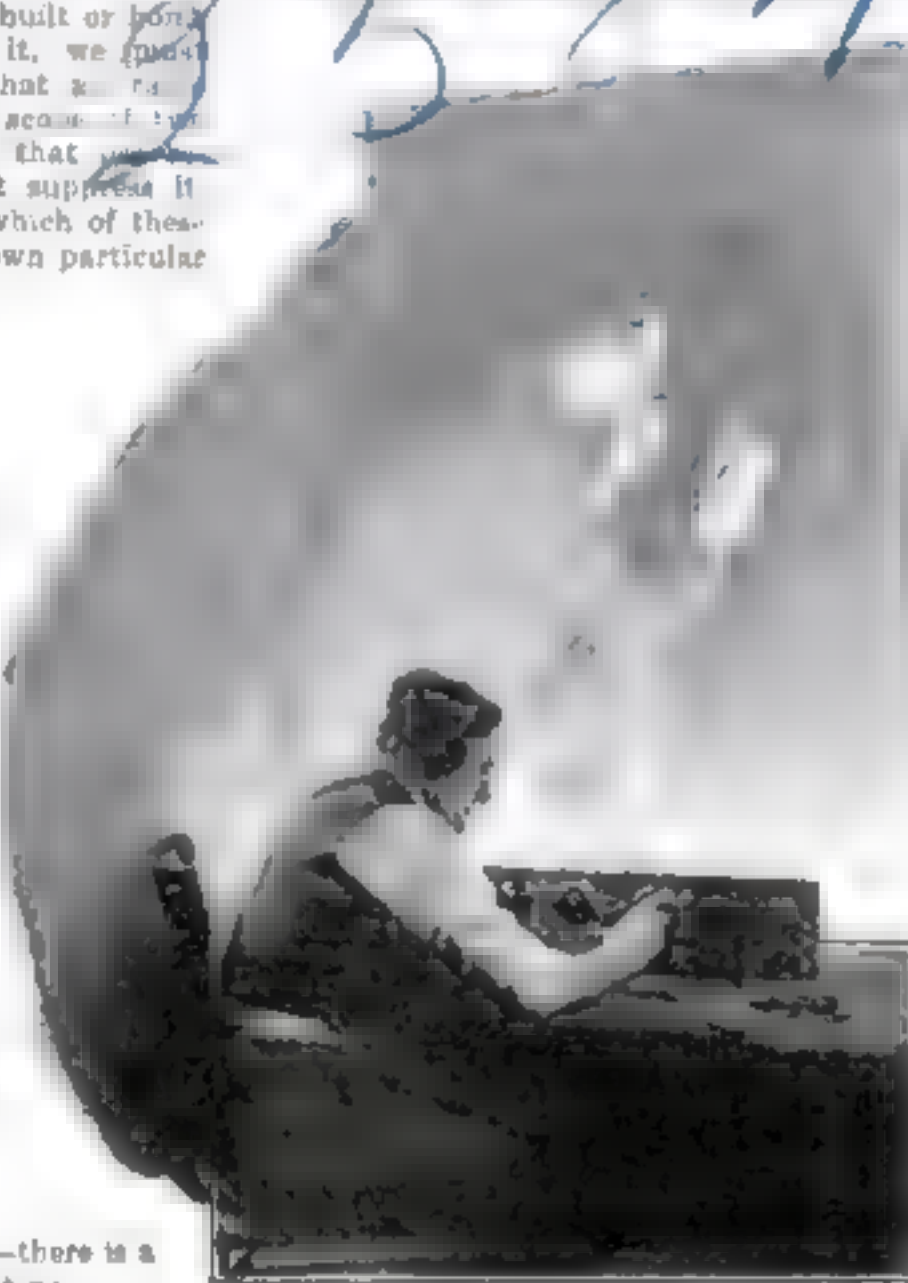
Perhaps the greatest trouble from radiating sets is caused by the inherent desire of the operator to get a little finer adjustment from his set. He is never satisfied, but must continue to fiddle with the controls. This is an extremely bad habit, because it invariably causes the terrific squeals heard in other receiving sets in the neighborhood. It spoils the enjoyment not only of neighbors, but also of the fan who is forever tinkering with his dials. As soon as you have a good adjustment with the desired broadcasting station, leave your set alone. Then it will give you maximum efficiency.

Should you hear any sign of a whistle or other noise in your set, and you are reasonably convinced it is not coming from the transmitting station, reduce your filament current by making a slight adjustment on the rheostat controlling the detector tube. If this does not remove the trouble, then adjust the regenerative coil. The reason for this is a very important one:

## When the Set Is Too Sensitive

Putting your set into a too sensitive condition causes the set to howl and whistle at the slightest provocation. When your set whistles, you are using up too much energy from the storage or dry cell battery to light the filaments, or are using too tight coupling between tickler and tuning coil.

For the single-circuit receiver there is always one best combination of dial settings for every transmitter. That combination will be found by tuning the aerial circuit first before touching the regeneration.



The tuning dials of your radio receiver are like the sensitive combination dial of a safe. They require careful precise manipulation. For every broadcasting station you wish to hear there is a definite combination that will open the door of your set to the most satisfactory results in radio reception. Don't be simply a dial twister.

controlled by a coupling or tickler coil. Place this coil so that the coupling between it and the aerial coil is at about 90 degrees. Now make the condenser and switch adjustments of the aerial circuit very slowly until the voices or music from the broadcasting station are heard. A little careful movement of the controlling dial of the condenser soon will show what position gives the loudest signals.

As soon as this adjustment has been completed, the regenerative coil can be brought into closer coupling with the aerial coil, but this movement also should be made very slowly and carefully. The signals will increase in volume rapidly until they reach a point where the set "spills over" and goes into oscillation. Come back immediately to the position just preceding that, because it is in this position that your set is in its most effi-



Consider now the tuning of receivers where regeneration is deliberately suppressed—the neutrodyne, the superdyne, and transformer-coupled radio-frequency amplifiers. All utilize the principle of amplifying the carrier wave of the broadcast stations before detection is accomplished. In the neutrodyne this is accomplished by opposing two capacities against each other; in the superdyne by opposing two magnetic fields, and in the transformer-coupled radio frequency by introducing resistance in the circuit.

In tuning the neutrodyne, the three controlling dials always must be set at the same points for any particular station. An important point to remember, however, is that, under no circumstances should the filament current be too high. Otherwise the neutralizing balance of the set may be upset, producing regenerative squeals. High filament current is unnecessary, spoils reception, and is costly.

### Tuning the Superdyne

The best way to tune the superdyne is to place the negative feedback coil at maximum coupling so that there is complete neutralization, then tune the aerial and plate condensers slowly and carefully until signals are heard. If this rule is followed, the set never will squeal, and the best possible results will be obtained. Here, too, the filament current should be kept as low as possible consistent with good reception results.

In transformer-coupled radio-frequency amplifying sets, regeneration is controlled by a potentiometer placed across the filament battery. This is so connected into the circuit that it controls the grids of each of the radio-frequency tubes, and is said to control the amount of positive or negative bias on the grids. The potentiometer also dampens out any possible regeneration by adding resistance to the grid circuits.

Since resistance causes losses in any receiver, we are really using one evil in this case to overcome another that happens to be slightly worse. The problem, then, in radio-frequency amplifiers using fixed transformers is to keep the resistance as low as possible, while preventing regeneration in the amplifier. The best way to do this is to keep the filament current as low as possible. Thus we can reduce the amount of resistance actually being used in the grid circuits, and thus approach a closer negative bias on the grids without the set going into oscillation.

### Losses Caused by Shielding

Amateurs long have called the potentiometer a "losser." This is a very apt phrase because it expresses the actual function of the instrument.

While on the subject of losses it would be well to point out to fans who make their own sets that shielding should be avoided

as much as possible. This adds losses to a set. Never put a condenser inside a coil, no matter how much space you desire to save. In serial circuits it is always best to have the aerial condenser in series with the aerial tuning-coil. The movable (or rotor) plates of the condenser should be joined with the aerial, and the stationary plates of the condenser with the coil. The use of a shield then is unnecessary. Where a double circuit is used with a

coming loose inside, otherwise you will be troubled with noises in your set for the rest of its life. If a compression type of leak is used, make sure there is no possibility of looseness.

A well-designed variable pencil marking is as good as anything. If such a leak is used, adjust it for the tube employed as a detector, and when the best position is found, leave it alone. The same is true for the grid condenser. Remember that when a grid leak is used—whether it is of the fixed or variable variety—the return lead of the detector tube grid circuit must terminate at the positive side of the A battery.

There are many little details in the audio-frequency side of a receiver that materially affect the efficiency of a set. No matter how perfectly the radio-frequency and detector side of the circuit may be constructed, efficiency will be completely destroyed if the audio amplifier is not constructed correctly. Moreover, serious distortion will be experienced.

### Use of the C Battery

With the new type of low-consumption filaments in all modern tubes, it is imperative that a C battery be used on the audio amplifiers, where more than 45 volts are put on the plates of the tubes. Do not forget, however, that if you can obtain sufficient volume with 45 volts, it is extreme folly to increase the voltage. The reason is that, in accordance with Ohm's law, the current drain from the B batteries will be increased the moment we add more voltage, and consequently their life will be shortened.

Naturally there are many cases where sufficient volume cannot be obtained to work a loudspeaker satisfactorily below 90 volts. In such cases a C battery is absolutely necessary, and it should be at least 4½ volts in value.

In the audio-frequency side of a receiver, the rheostat

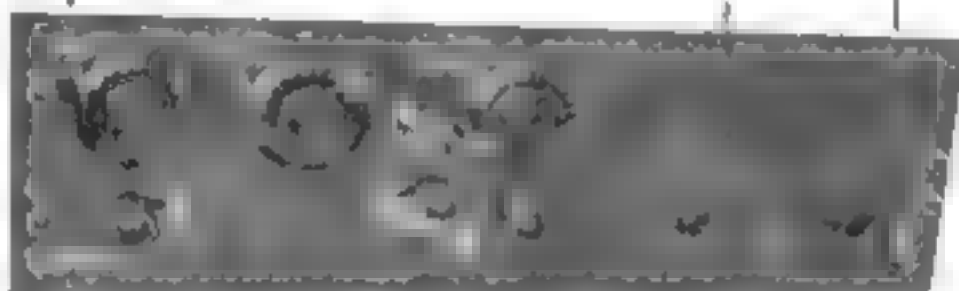
always should be placed in the negative side of the filament, and the connection from the secondary of the audio transformer should be joined to the negative filament lead at some point between the battery and the rheostat.

### One Battery for Both Stages

A C battery, when used, should be put in at this point. In other words, the positive side of the C battery should be joined with the negative lead of the filament circuit at a point between the rheostat and the A battery, and the negative lead from the C battery then should be joined with the filament side of the audio-transformer secondary. One C battery may be used for both stages of audio frequency, provided the instructions given above are fully followed.

Next month Jack Binns will tell how to select radio parts to get best results.

1. Call letters	WDAP
2. Location	CHICAGO, ILL.
3. Owner of station	CHI BD OF TRADE
4. Distance	700
5. Wave length	360
6. Kilocycles	830
7. Power of station (in watts)	1000
8. Date received	1/29/24
9. Hours received	11 PM
10. Circuit used	REG ONE-TUBE
11. On what stage received	DETECTOR
12. Phono or loudspeaker	LOUDSPEAKER
13. Good, fair or poor	FAIR
14. Settings	
Dial 1	60
Dial 2	47
Dial 3	42
Switch 1	SWITCH PL 1
Switch 2	SWITCH PL 2
Switch 3	SWITCH PL 1
Remarks	RATHER CRIPPLED



The table above suggests a convenient method of keeping a permanent tuning record of each broadcasting station you bring in. By dividing paper into lined columns (one column for each station) and jotting down notes opposite the numbered headings as indicated, you will have an invaluable chart of tuning combinations for reference.

condenser across the secondary coil, the stationary plates of the condenser should be connected with the grid side of the coil, and the rotor plates with the filament side. No shield then will be necessary to protect the set against body capacity.

We now come to a consideration of the detector tube—which after all is the most sensitive element in a receiving set. The use of modern hard tubes has eliminated much of the extra sensitivity and allows for more stable operation, since these tubes are not at all critical to filament current and plate voltage. It is imperative, however, that not more than 45 volts be placed on the plate of a detector tube. Experimentation soon will determine which is the best voltage to use there.

A well-constructed mica variable condenser can be employed as a grid condenser with maximum results. A variable grid leak also may be used, but great care must be exercised in choosing it. Do not take one that shows any possibility of be-



# How to Build a Loudspeaking Three-Tube Radio Receiver

By Joseph Calcaterra

Radio Editor of POPULAR SCIENCE MONTHLY

**W**HAT is the ideal three-tube receiver for home construction? This question has called forth volumes of letters from radio fans who like to build their own sets and to experiment with various types of instruments.

It is generally conceded that a receiver, to be efficient, must be a good distance-getter, simple to operate, with loudspeaker volume on distant stations. It must be so simple to construct that it will not require weeks or even months of time to put it on an operating basis.

## The Ideal Circuit

In constructing a three-tube receiver there is at least one type of circuit that, if correctly designed, meets these requirements and assures satisfaction. It is the Armstrong three-circuit hook-up—a circuit that has stood the test of time, and has won a reputation for ease of construction, efficiency, and simplicity of operation.

As shown in the wiring diagram at the bottom of this page, the circuit consists of inductively coupled primary and secondary circuits with tickler coil feed-back for regeneration. Vernier variable condensers of .0005 mfd. capacity usually having 23 plates, are used across primary and secondary circuits to provide for fine tuning

## Winding the Tuning Elements

The primary and secondary coils are wound on the same tube, and regeneration is provided by the rotor of the variocoupler which acts as a tickler coil.

Concentrating the tuning elements in this manner allows plenty of space for the other parts and wiring. Since all the tuning coils are close together, long, straying wiring is unnecessary to connect the detector unit, and it is in this way that interaction between circuits is eliminated.

Variation in coupling can be obtained by shifting the switch arms of switches 6 and 7 to the upper or lower portions of the secondary coil. This varies the distance from the portion of the secondary coil between the two switches to the primary coil, and consequently makes the coupling loose or close, depending on whether the upper or lower portion of the secondary coil is included between the switches.

Since the receiver is very sharp in tuning—a desirable feature in eliminating interference—some practice is required before famil-

iar in tuning is obtained. It is advisable, therefore, to give the receiver a thorough trial for at least a week before attempting to make any changes.

By using a 7 by 24 inch panel it is possible to arrange the parts as shown in Fig. 2, so as to permit complete separation of grid and plate circuits. To facilitate construction and wiring, all parts in the wiring diagram have been numbered to correspond to the numbered parts shown in the rear view photograph of the receiver (Fig. 2).

Numbers 1 and 2 are the aetal and ground posts respectively. Numbers 3 and 10 are .0005-mfd. Vernier variable condensers. Most 23-plate condensers have this capacity. Since the tuning of the set is very sharp, it is absolutely necessary that the Vernier type of condenser be used.

Numbers 4, 5, and 7 are inductance or

tap switches. Number 4, which is hidden from view by condenser 3, is a four-point switch and is used to vary the number of turns of the primary coil 5A. Number 6 is a four-point switch with which the first four taps of the secondary coil are connected, and No. 7 is a three-point switch with which the last three taps of the secondary coil are connected.

## The Special Tuner

Number 5 is the special tuning unit. This unit is similar to a standard variocoupler in general appearance, but different in actual construction. The winding A forms the primary inductance of the tuning system, the winding B forms the secondary inductance, while winding C on the rotor serves as the tickler coil to provide regeneration.

A standard variocoupler having a stator tube from 3 1/4 to four inches in diameter, and at least four inches long, can be rewound, or, as was done in this case, a special coupler can be made at home. The stator tube of this variocoupler was four inches in diameter and 4 1/4 inches long. The primary winding was started one half inch from the top end of the tube and 60 turns of No. 22 D.S.C. wire were wound on, taps being taken at every 10 turns. Counting the two ends of the winding, this made seven taps in all.

## Method of Tapping Coils

The taps were taken at the right of the coupler, looking at it from the front, and were made in a straight vertical line about 1 1/4 inches to the right of a center line dropped from the front end of the rotor shaft. This brought the taps within easy reach of the switch points of switches 6 and 7 and greatly facilitated connections of the taps with the switch points.

The beginning of the primary winding was started one quarter inch below the end of the secondary coil. Forty turns of No. 22 D.S.C. wire were used on this winding and taps were also taken at every 10 turns. The taps were made in a vertical line down the side of the variocoupler, but in this case they were made on the left-hand side so as to be close to the switch points of switch 4.

The C winding consists of 40 turns of the same kind of wire. It is not absolutely necessary that D.S.C. wire be used, or that the size be exactly No. 22. Single or

*(Continued on page 138.)*

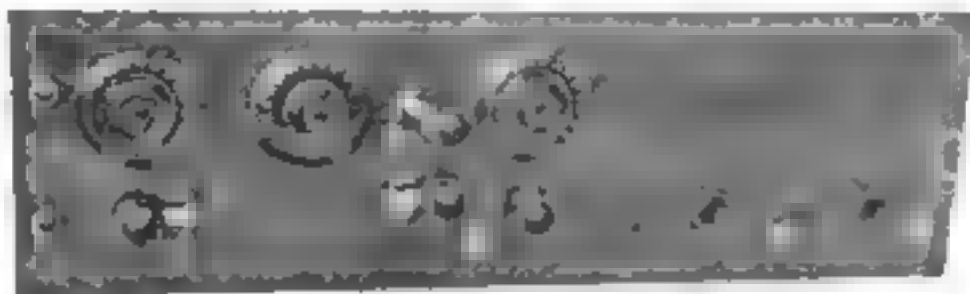


Fig. 1. Front view of the three-tube receiver, showing panel layout

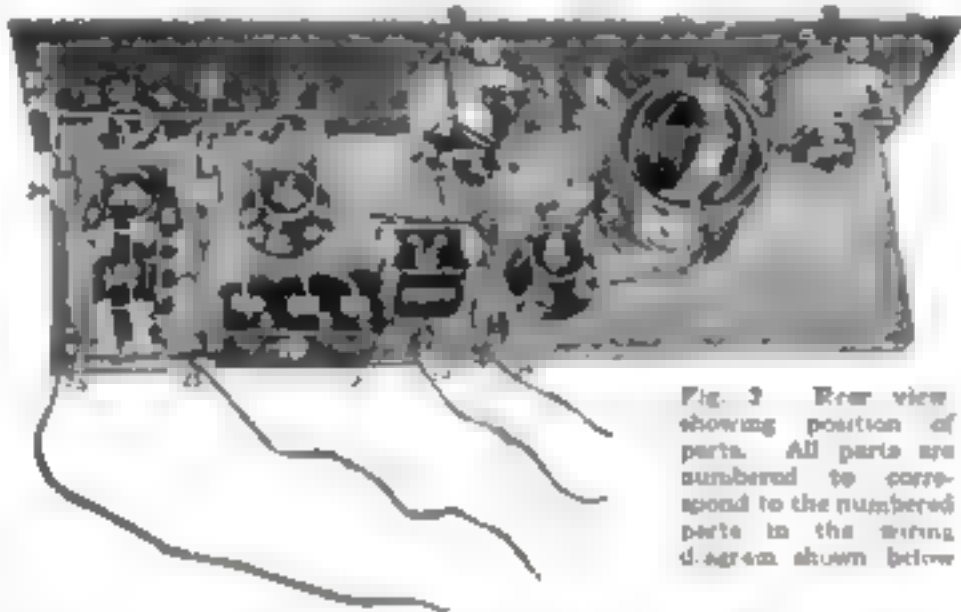
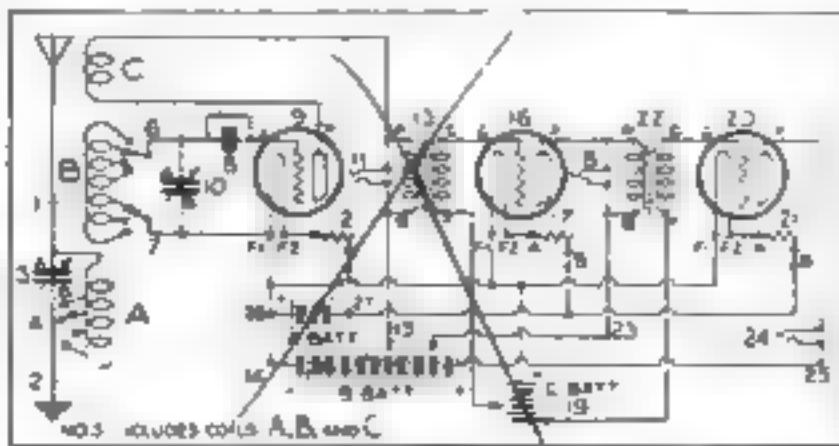


Fig. 2. Rear view showing position of parts. All parts are numbered to correspond to the numbered parts in the wiring diagram shown below



Wiring diagram of the three tube receiver with parts numbered to correspond to those shown in the rear view (Fig. 2)



# Mechanical Gearless Transmission

*British Inventor Applies Pendulum Principle in New System*

**G**EARSHIFT transmission for automobiles may be made obsolete within a few years by a revolutionary new invention that connects the engine with the driving wheels without the use of any gears whatsoever. It is the work of George Constantinesco, a distinguished British engineer.

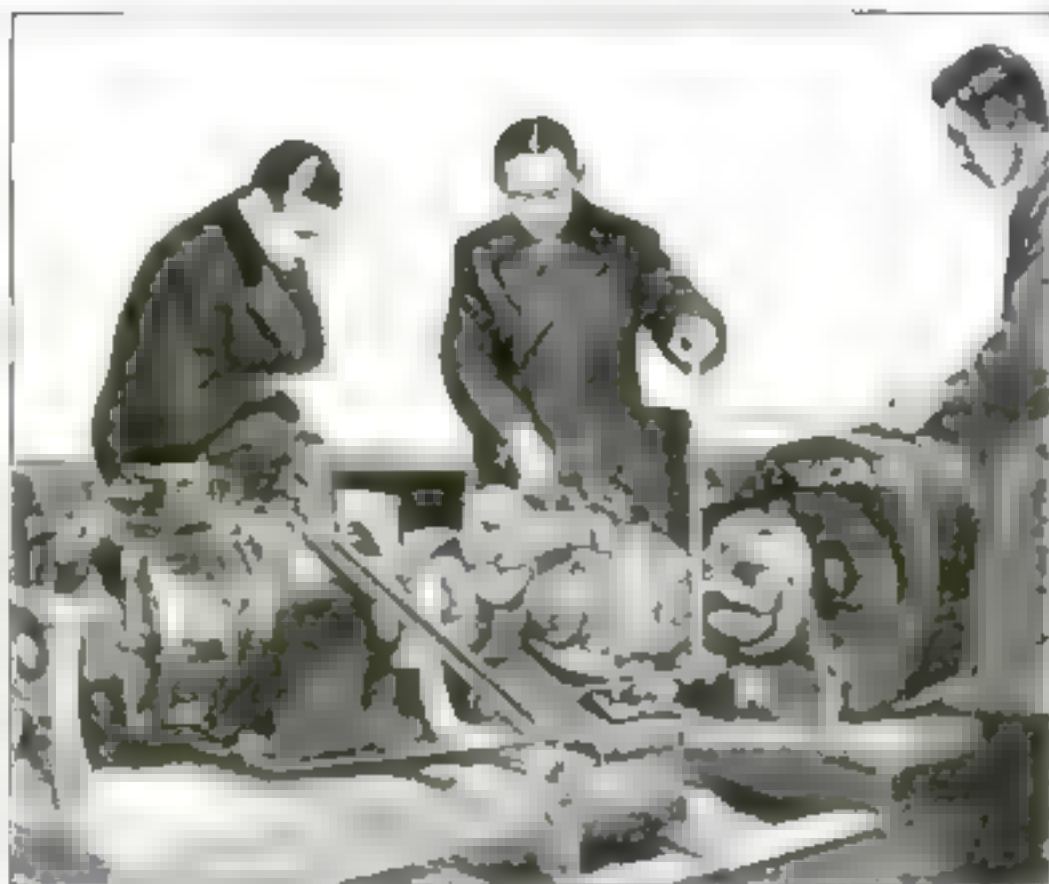
The astonishing claims made for this invention, which is said to accomplish what automotive engineers have been attempting for years, comes with exceptional authority because of the fact that Mr. Constantinesco has achieved a brilliant record of invention, including the revolutionary timing gear that allows a machine gun to fire between the whirling blades of an airplane propeller.

In discarding traditional theories of speed conversion, Constantinesco claims to have eliminated the inefficient and troublesome auto gears, forward and reverse, the clutch and the rear axle drive system.

Like other automobile transmission systems, the reciprocating motion of the pistons turns a main power shaft. By means of a crank and three links, the motion of this shaft is transmitted through an oscillating flywheel directly to the final drive shaft. It is in this system of links, crank, and an oscillating flywheel that the invention centers. It is best understood by using a cane with a large and heavy knob as an analogy.

With one hand hold such a cane by the tip, the knob down, and press slightly against the side a few inches below where you are holding it. The knob will swing slowly, like the knob of a pendulum. Now press, with increasing force and frequency, on the same point. The knob will attain a certain speed of swing. After that it will swing less and less as the force and frequency of your pressings increase. But the hand holding the tip will begin to move more and more. Ultimately the knob will remain stationary and the hand holding the cane will move with strong, regular impulses.

The hand that exerts the pushes against the cane corresponds to the link from the main power shaft in the Constantinesco transmission. This link transmits power from the shaft



George Constantinesco (center) demonstrating his new gearless transmission system with the aid of an electric motor at left and a brake drum at the right. In the center is the pivot transmission mechanism the operating principle of which is shown in the diagrams.

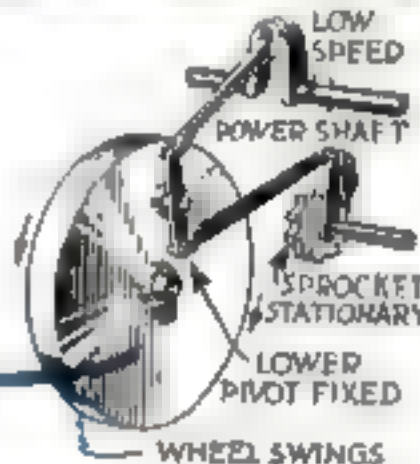
to the oscillating flywheel, which acts precisely as would an ordinary pendulum. That is, it swings back and forth instead of turning all the way around.

When the motor is running slowly, the impulses delivered to the flywheel correspond to the first slow pressures on the cane. The pendulum merely swings back and forth, the movement at the pivot being too slight to affect the wheels. But as the motor accelerates, the pendulum swings less and

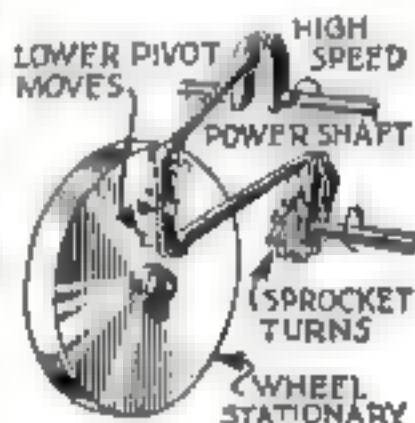
less, and the pivot, corresponding to the hand that held the cane, moves more and more. Should the speed become great enough, the pendulum would become stationary, and all the motion from the power shaft would become motion of the pivot.

The motions of the pivot are transmitted through a ratchet wheel to the shaft that drives the rear wheels. In this manner, the greater the power developed by the engine, the greater the movement of the pivot and the greater the speed transmitted by the pivot, through the ratchet, to the wheels.

Obviously, the motor can idle while the car is standing still, if it is run so slowly that the pivot moves but slightly, the power being used up by oscillations of



When the engine is running slowly the flywheel swings like a pendulum while the pivot connected through links with the drive shaft remains motionless.



When the engine is running at high speed the flywheel remains motionless, while the pivot moves to turn the sprocket wheel attached to the drive shaft.

the flywheel. Accelerating the motor diminishes these oscillations, and increases the movements of the pivot. These are transmitted to the driving shaft.

A single lever, the design of which has not been revealed, controls forward, reverse, and neutral. This lever merely shifts the links without disengaging any of them, and operates no gears. Thus there are no gears to be stripped, it is claimed, and greater efficiency is obtained. The mechanism for this system, the inventor asserts, will require no more space than the present gear boxes, and will weigh even less.

Since power cannot be transmitted backward through this system, cylinder compression cannot be used for braking. The inventor considers, however, that because of the efficiency of modern brakes this will be no real handicap in the operation of a car.

## Know Your Car

**The Pulse of Your Car**—You can learn to diagnose the ills of your engine from the action of your spark plugs, just as a doctor detects your bodily ailments by feeling your pulse. Your car may have a diseased cylinder or valve. It is the spark plug that tells the tale.

Some people have an idea that if they remove and clean the spark plugs every few hundred miles, they have done all that is necessary. This is a mistaken notion. If your plug fouls, it is more important to go to the root of the trouble than simply to clean it.

See that the valves all seat properly. It may be that the valve tappet does not allow the valve to close with the result that compression is lost and the gases in the cylinder do not burn up completely.

It is possible that the piston rings are worn or the cylinder is scored. In either case oil will come up into the combustion chamber and settle in the form of a heavy smudge over the plug points.

Leave the plugs in place until the engine indicates trouble. Then remove the cause.



# Save a Fourth of Your Gasoline

## How to Get Greater Power from Your Car with Less Fuel

By F. A. Platte

Department of Physics, Columbia University

**R**ETURNING from an 1100-mile motor tour not long ago, I chanced to tell a friend that I had the gas tank filled only four times while away. In other words, that I had used about 60 gallons—approximately 18 miles to the gallon.

"Do you expect me to believe that?" he demanded. "A seven-passenger car, fully loaded, averaging 18 miles to the gallon on such a trip?"

I did not succeed in convincing him until I had shown him the notebook in which I make daily records of mileage, gas consumption, and similar data relative to my car, a little book, by the way, that saves me many dollars every year because it aids in important economies.

### More than Luck

"Well, all I have to say," was his comment then, "is that you're pretty lucky."

But it wasn't luck. I can say that without boasting. The gas consumption was exceptionally small for a car of the size—possibly 25 per cent less than the average—but it was due entirely to the fact that careful adjustments and the removal of unnecessary resistances had resulted in getting maximum power out of the fuel burned.

This is a thing that you also can do by getting acquainted with your car. Getting more miles to the gallon—a goal of most motorists—is not difficult. It is merely a matter of avoiding waste in fuel, which depends on two factors—yourself and your car.

First and foremost, there is the matter of driving. It really is surprising how much fuel can be saved merely by keeping your foot off the accelerator when there is no necessity for having it there; in other words, coasting when you can. In a long day's drive coasting might save a quart or more of gasoline.

For example, on the trip that I mentioned I traveled more than two miles at 30 miles an hour along part of the Mohawk Trail in New York State with the

ignition shut off and without stepping on the brake. It was a gradual slope, and the weight of the car was sufficient to keep it going as fast as the law allowed, while the compression of the motor was sufficient to prevent the car running away without my having to step down the brake lining. At

tank. Soft tires make easier riding, but you pay for it many times over in the gasoline you waste.

If your front wheels are out of alignment, the tires will slide somewhat instead of rolling. That causes friction and consequent fuel waste, too; not a tremendous amount in a day's run, but a waste that becomes appreciable in a season's driving.

Dragging brakes are obviously prodigal of gas. Keep your brakes properly adjusted and you will effect a double saving—in gasoline and in brake linings.

Since the motor is where the fuel is consumed, it is natural that this is where it also frequently is wasted. If connecting rod bearings are too tight or not properly lubricated, added power is necessary to turn over the engine. Once again the only source from which the needed power can be drawn is your gas tank. Also, should improper lubrication be the trouble, there is the added danger of burning out the bearings.

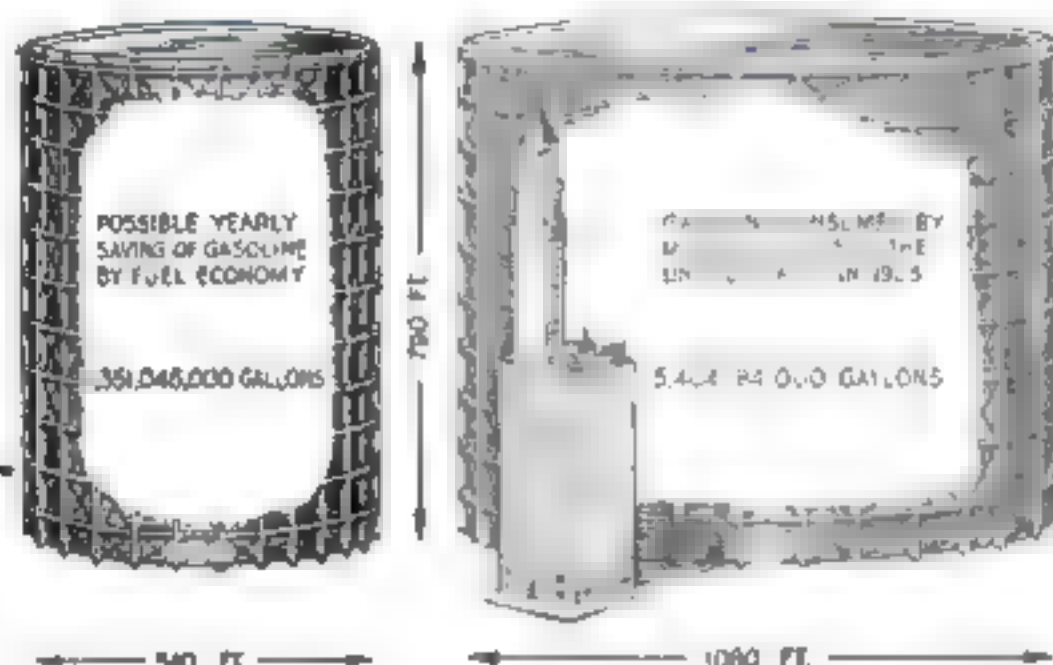
Carbon deposits in the cylinders cause unbelievable quantities of gas to be wasted. I was riding with a physician a few months ago, and in going up a short and not particularly steep hill it was necessary for him to shift to second in order to make the grade. I asked him why he didn't have the carbon removed from his cylinders, and he replied that he couldn't spare the car long enough to have it done.

### Carbon Wasteful

"You'll have to have it done sooner or later," I told him, "and in the meantime every two weeks or so you're wasting enough fuel to pay for the job, besides having the inconvenience of driving a car that won't take a short hill."

Before I left him he agreed to have the carbon removed and for a few weeks to keep a careful tally of his mileage as compared with his gas consumption. It astonished him to find that his mileage increased between eight and 10 per cent after the carbon was removed.

But the most voracious devourer of



Last year the 14½ million motor vehicles in the United States consumed 5,404,184,000 gallons of gasoline—enough to fill a tank as high as the Woolworth Building and more than 46 times its volume.

Of this total consumption, 172 gallons for each car—automobile and truck—estimate that at least one fourth or 1,331,046,000 gallons, might have been

saved by economy in car operation. This wasted fuel would fill a tank of 11½ times the volume of the Woolworth Building. It represents 93 gallons consumed each year unnecessarily for every car in the country.

A number of simple methods of gasoline economy in car operation are listed below. Try them out on your car. Keeping track of your gas consumption

### Ten Ways to Save Your Gasoline

1. Coast whenever you can. Keep your foot off the accelerator as much as possible.
2. Keep your tires well inflated.
3. See that your brakes do not drag.
4. Be sure connecting-rod bearings are not too tight and are well lubricated.
5. Keep engine cylinders free from carbon.
6. Adjust the carburetor to a mixture in the ratio of 15 parts of air by weight to one part of gasoline.
7. Keep spark plugs clean and free from carbon to assure a strong spark for ignition.
8. Adjust the spark-plug points to .025 inch apart—about the thickness of a well-worn dime.
9. See that your battery is well charged.
10. Keep engine valves ground to seat well.

other times I coasted distances ranging between a quarter of a mile and a mile. No tremendous saving perhaps in each instance, but the total ran into valuable dollars before the trip was ended.

You can walk with less effort in well-fitting shoes than you can if your feet are encased in burlap bags. Similarly it requires less expenditure of power by your motor to propel your car on well-pumped tires than on tires that are soft.

When your tires are flat, your car is going uphill continuously. There is only one way in which the motor can obtain the necessary power to compensate for dragging tires, and that is from your gas



gasoline is the carburetor when incorrectly adjusted. You can have the adjustment made at any service station for a nominal fee. But the job is easy and you soon can learn to do it if you wish.

The carburetor, as every one probably knows, is where gasoline is mixed with air to provide a explosive mixture of fuel for your engine. It can be adjusted to produce mixtures in infinite number. Only one mixture is correct, though. Hence the necessity for getting the right mixture and keeping it.

### The Happy Medium

When the mixture is in the ratio of 10 parts of air by weight with one part of gasoline, it is too rich. Black smoke will issue from the exhaust. The engine will labor and puff like a man out of breath. There will be little power in the motor, and most of the gasoline you are feeding to the carburetor will be going out of the exhaust.

When the ratio is 20 to 1, the mixture is too lean. Probably it will be impossible for you to get the motor to run. If you succeed in doing so, it will run very fast when idling, but will lack power to move the car and probably will stall the instant you throw in the clutch.

These are the two extremes of carburetor mixtures. Between them lies the proportion of air to gasoline that you must seek—15 to 1. This mixture explodes violently, and gives power and speed to the motor.

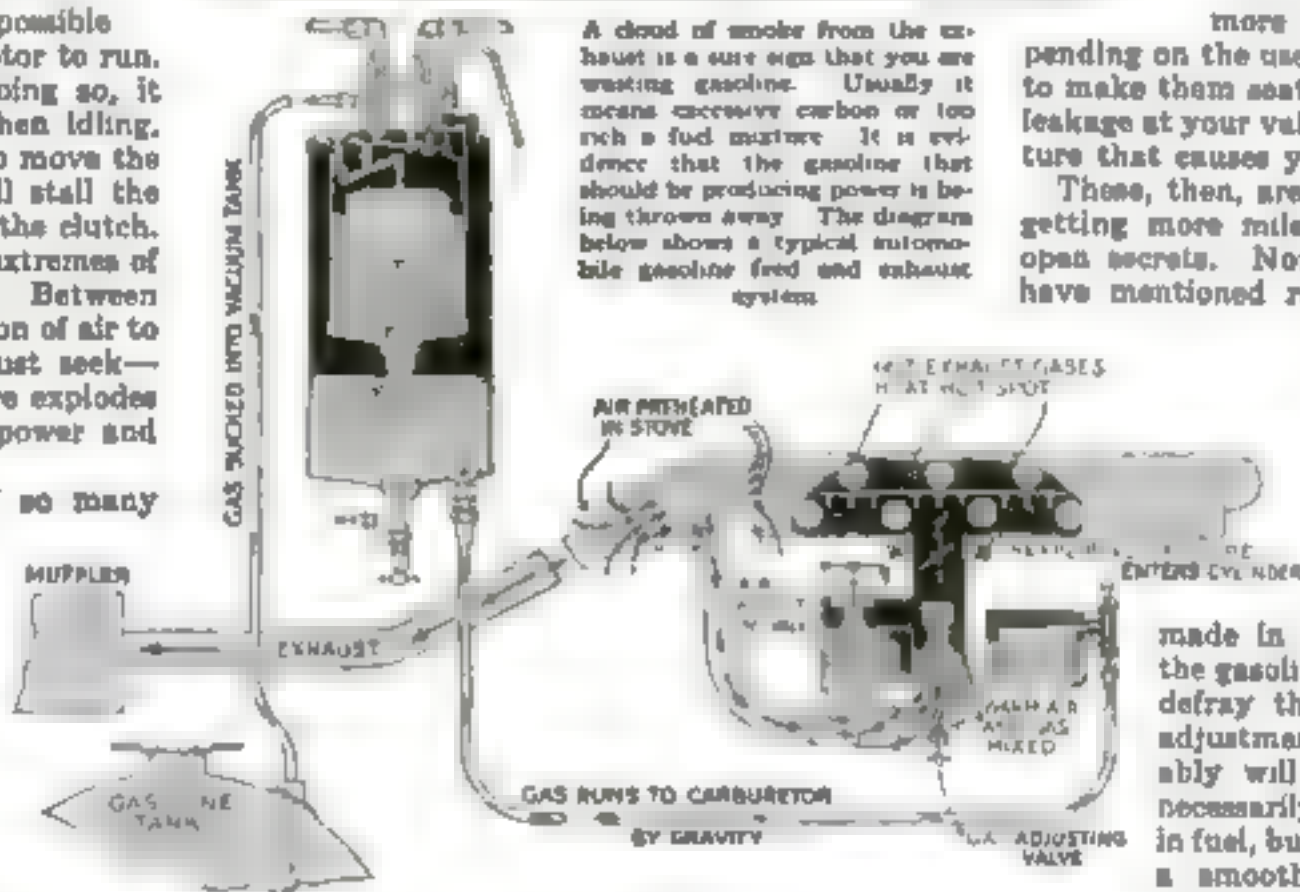
Carburetors are of so many different types that no fixed rules for adjusting them can be laid down in a few words. You must study your own carburetor, judge from the action of your motor whether the mixture is too rich or too lean, and then make your adjustments accordingly.

The carburetor should be adjusted for normal running conditions. Hence, the motor should be warmed up before you attempt to make an adjustment. As a first step, ascertain from the instruction book supplied by the manufacturer of your car whether the carburetor has controls both for gas and air or for gas only. If there are two controls, let your motor run with the spark retarded and close the needle valve controlling the gas supply until the motor idles smoothly. What you are seeking is the minimum gas supply that will produce a slow, quiet running of the motor, without jerkiness.

Next, advance the spark and give the adjusting screw of the air control a turn or two to tighten it. Open the throttle quickly. If dense, black smoke issues from the exhaust, the mixture is too rich. Turn the air control in the opposite way, testing by opening the throttle at every

half-turn or so. Gradually the smoke will become less dense, and eventually there will be a point at the carburetor, signifying that the mixture is too lean.

When this point is reached, adjusting the air control in the opposite direction, stop testing with the throttle at every half-turn, until you get the air con-



A cloud of smoke from the exhaust is a sure sign that you are wasting gasoline. Usually it means excessive carbon or too rich a fuel mixture. It is evidence that the gasoline that should be producing power is being thrown away. The diagram below shows a typical automobile gasoline feed and exhaust system.

trol in a position where the motor accelerates instantly and without smoke when you open the throttle. Your carburetor is then in fair adjustment, which can be improved further by making finer tests, moving the air control nut by small fractions of turns in either direction.

### Let Well Enough Alone

After this, test your car on the road. If it picks up immediately when you press the accelerator and shows power on hills, you may be satisfied that your carburetor adjustment is correct. My advice is to let it stay that way as long as the car runs well.

If your car has a fixed air valve, all changes must be made on the gasoline line. There will be a nut or screw that moves the needle valve in the nozzle. This must be turned until the correct amount of gasoline is being fed to the carburetor.

Tests of the mixture are made exactly as with cars having both gasoline and air controls.

A good, strong spark is absolutely essential to rapid burning of the explosive mixture that passes from your carburetor to your cylinders. Hence, you should see that the spark plugs are kept clean and free from carbon. They should be cleaned occasionally by immersing them in kerosene and removing the carbon with a small, stiff brush—a typewriter type brush or a toothbrush with stiff bristles will serve—or they should be scraped with a pocket knife, nail file, or some similar small, sharp tool.

### Adjusting the Points

The points then should be filed bright and adjusted to .025 of an inch—about the thickness of a well-worn dime. Your battery also should be kept properly charged, and, if you have a magneto in your car, the carbon dust should be cleaned out occasionally.

Valves should be ground more or less frequently, depending on the use you make of your car, to make them seat well. Sometimes it is leakage at your valves and not a lean mixture that causes your carburetor to pop.

These, then, are some of the secrets of getting more miles to the gallon—very open secrets. None of the operations I have mentioned requires any extraordinary amount of labor or trouble. They are all things you can do yourself. If you don't care to tinker with a car, though, you can have any of the above adjustments

made in a service station, and the gasoline you will save should defray the cost of making the adjustments. In fact, you probably will make a profit; not necessarily through your saving in fuel, but because you will have a smooth-running, dependable car that will serve you whenever you call upon it.

**NEXT month—The steering mechanism and its operation; how to keep it in good working order for your safety and comfort**

ONE way to get more miles to the gallon and to keep your car running at highest efficiency, Mr. Platte points out, lies in having your carburetor always in proper adjustment.

Mr. Platte has explained the general principles by which such adjustments are made. If you should wish more specific instructions, send a stamped, self-addressed envelope for reply to the Automobile Editor, Popular Science Monthly, 225 West 39th St., New York, N. Y., giving the following information:

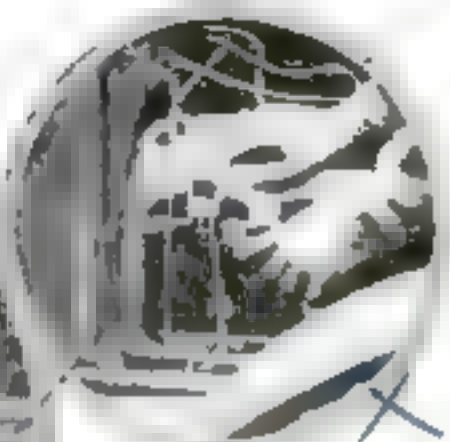
Make of car Model Year  
Make of carburetor Identification number



# Springtime Hints for Auto Touring



To prevent flaring of  
headlight beam, adjust  
the beam so that it  
falls on the road ahead  
of the car.



Automatic carburetor  
control is shown here by a hand  
pulling the lever  
which regulates the gas.



This pivoted head lamp  
control is shown here  
by a hand pulling the  
lever which operates  
the lamp.

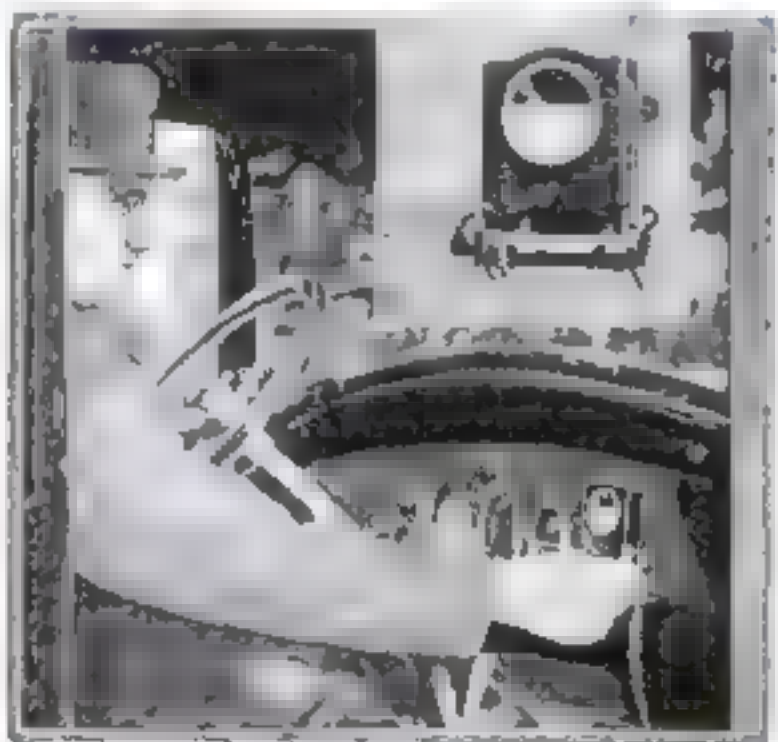
Seal the body of the car  
to prevent leaks of the  
two refrigerants. The  
seal is made by a hand  
pulling the lever which  
operates the lamp.



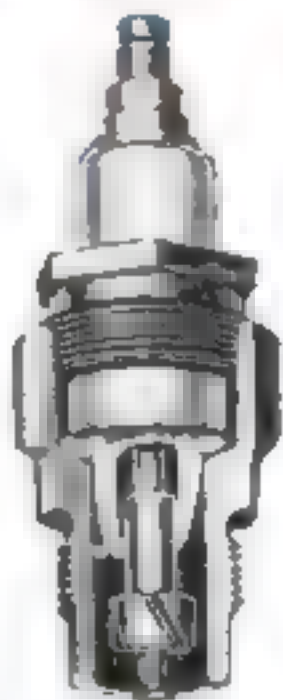
Hand operating at this  
point is shown here by  
a hand pulling the lever  
which operates the lamp.



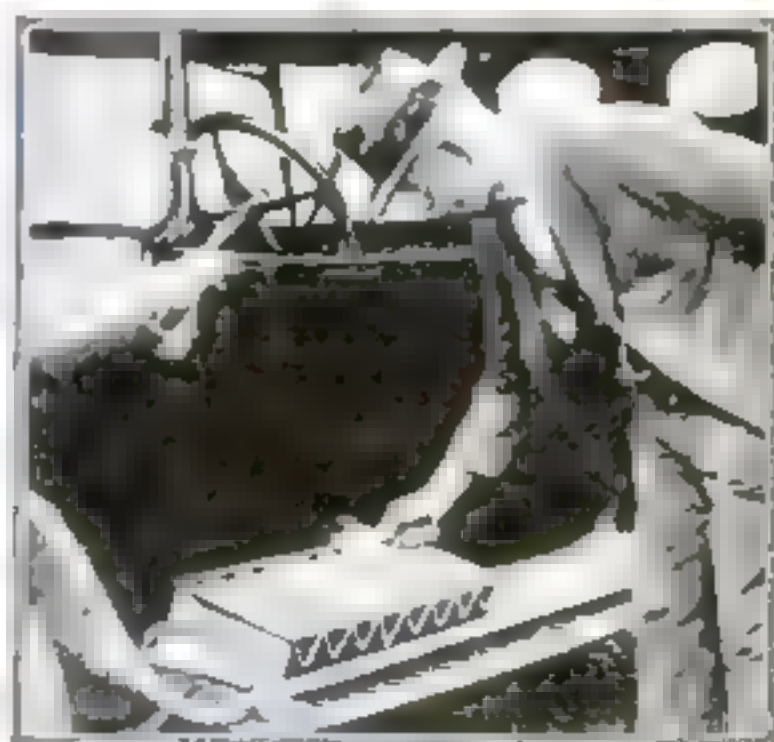
When not in use, this  
control is shown here  
by a hand pulling the  
lever which operates  
the lamp.



When the driver pulls a lever, this dash  
board cigarette holder sets one of its 15  
cigarettes and simultaneously lights it.



This spark plug auto-  
matically cleans itself.  
A spiral plunger moves  
on each impulse of the  
motor, sweeping the  
electrode of carbon.



An eight-compartment metal toe case for  
the driver's foot is shown here by a hand  
pulling the lever which operates the lamp.



# Fun and Profit in My Jack-Knife

By C. J. Reynolds, D.D.S.

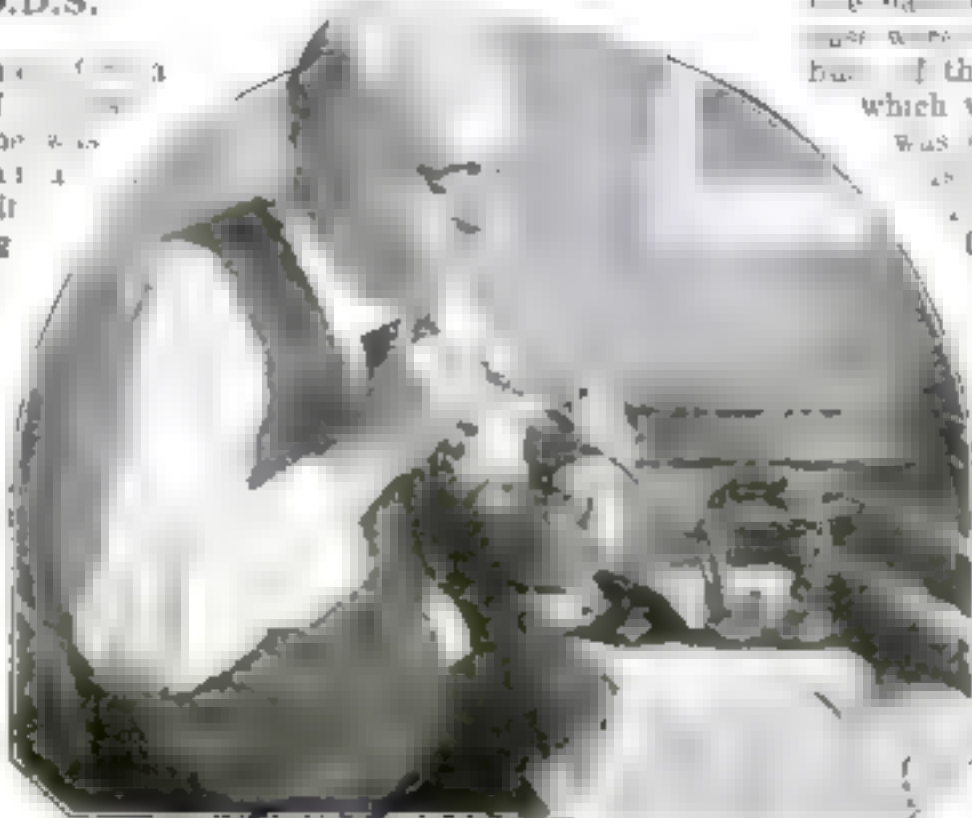
**J**ACK-KNIFE whittling, which some time appeared to be one of the arts, is coming back. Time was when every American man had a jack-knife and knew how to use it. This skill, acquired through long practice, stood him in good stead in many emergencies throughout life.

For my own part, I consider time I have spent with my knife entirely well spent, and I am glad to see the art of wood-carving revived. In fact, a great deal of such success as I have had is directly traceable to it. The manual dexterity I acquired through using a knife has been tremendously useful to me in the practice of my profession—dentistry. For one thing, unlike many of my brother dentists of the present day, I do all of my own laboratory work. And the ingenuity developed through fashioning intricate objects from shapes less like of wood has led to my inventing a few of the instruments that are used in modern dentistry.

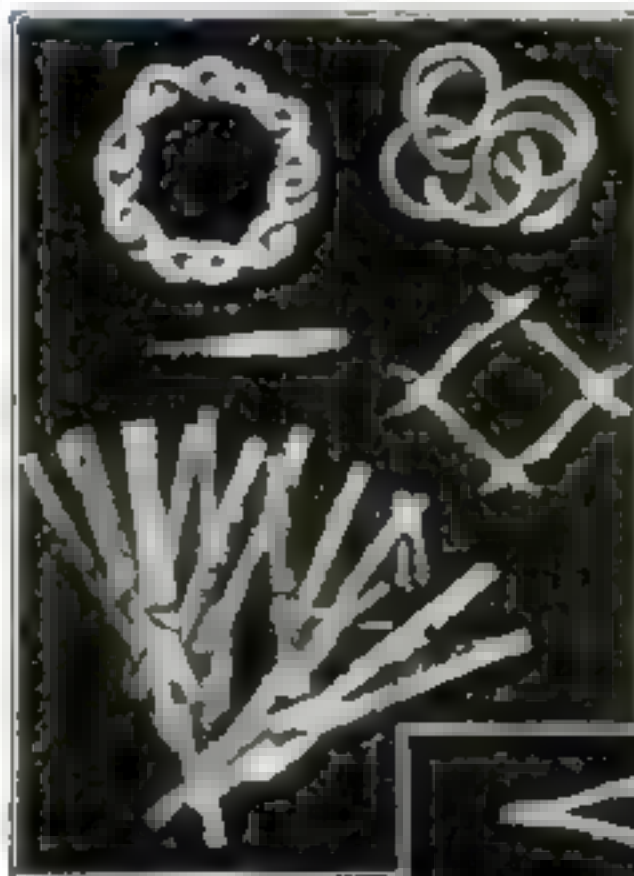
Beside from its usefulness, there is no pastime I know of that is so replete with pleasure. Although I was only eight years old when first I started to whittle, the pastime holds for me today as keen an enjoyment as it did then. Many evenings, after a laborious day in my dental laboratory, I turn with a sense of genuine relief to the good old jack-knife that I have treasured for the last 18 years.

## A Trophy of Revolutionary Days

Not long ago I read in the newspapers that Mr. S. H. P. Pell, of New York, who has a summer home at Fort Ticonderoga, on Lake Champlain, had salvaged the old hull of the war-ship *Revenge*, which had been sunk by American ships on October 10, 1776. I asked him to send me a piece of wood from the old ship. Mr. Pell answered my appeal by sending me a rib of oak from the hull, and from this I carved an inkstand, in the shape of a horseshoe to match a chair that 600 newspaper editors had had made from the timbers of the *Revenge* as a gift for President Harding. I mounted the horseshoe on a base that I carved from pieces of wood from three old American ships. The



Dr. C. J. Reynolds, Pittsburgh dentist and inventor of dental instruments, whittling the horseshoe and base. The inkstand is made of wood taken from the hull of the *Revenge*, *Royal Savage*, *Niagara*, and *Lawrence*.



Foot of Doctor Reynolds' penholder, carved from a piece of wood; a chain of eight interwoven rings; a chain of 33 separate rings; four-jointed pliers, and remarkable multiple pliers containing 33 separate plier joints.



Here the four-jointed pliers (top) and the 33-jointed multiple pliers are shown with the pliers closed. Each was carved by Doctor Reynolds from a single piece of wood.

base that affixed the horseshoe to its base was carved from wood taken from the hull of the American ship, *Royal Savage*, which was Arnold's flag-ship and which was sunk by the British off Valcour Island, Lake Champlain, October 11, 1776; the *Lawrence*, which was Commodore Perry's flag-ship in 1812, and *Niagara*, another one of Perry's ships.

The inkstand completed, I sent it to President Harding, and I received in reply a warm letter of thanks.

Among the other novelties I have carved with my jack-knife are a wooden mask of myself, which friends have pronounced an exact likeness, and an oil-drilling plant, fully equipped, inside a large bottle, which can be set in operation by turning the stopper in the neck of the bottle. This piece of work causes great wonderment as to how the plant was set up inside the bottle. I have also whittled a chain of eight twisted links, all cut from one round piece

of wood—six inches; six interwoven rings cut from one block of wood, three by five inches; a set of four-jointed pliers, cut from one piece of wood; a set of multiple-jointed pliers, containing 33 separate joints, all cut from one piece of wood, two by three by 10 inches; and a "ouija" board, made from a piece of the *Revenge*.

## Procure the Right Knife

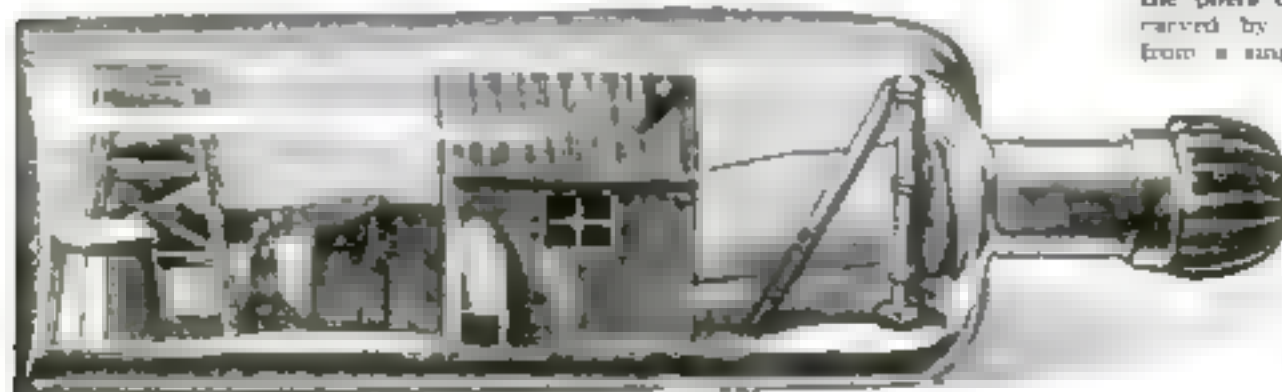
Not any knife, of course, will do for whittling. I have had many makes in my day.

The best I have found is a modern, patented pushbutton knife. The fact that the blades of this knife lock, both when open and shut, eliminates the danger of the whittler's cutting himself.

In sharpening a knife, I wear it down to an edge on a rough stone, then put a 30-degree bevel on it by means of a fine, smooth Arkansas oilstone. Then I strop the blade until I have an edge that will shave. I have several knives whose blades I have ground down to almost nothing in order to accomplish certain whittling tricks.

It is a fascinating hobby, and I'd advise every man to try it.

As for fathers of sons, aye, and of daughters, too, I'd advise every one of them to buy for a child a jack-knife as soon as he can handle it with a reasonable amount of safety. Of course he will cut himself at first, but it will not take him long to learn how to handle a knife, also it will teach him something constructive, and there's no telling when an unexpected genius will be discovered.



A remarkable miniature oil drilling plant, built within a bottle by Doctor Reynolds. The plant can be set in operation by turning the stopper of the bottle.





# The Home Workshop

Arthur Wakeling, Editor

## Modern Dining Alcoves that Save Labor

**T**HE dining alcove is a feature of the modern home that has come to stay. It saves valuable space in a time of housing shortage and high building costs. Even more important, it reduces materially the amount of walking back and forth necessary in serving breakfast, luncheon, and other informal meals.

Some of the most modern small homes have built-in Pullman dining alcoves located in or adjacent to the kitchen. This is particularly true of the newer type of house in which the dining-room is combined with the living-room or is merely an extension from the living-room. The value of a separate dining-nook for the informal meals in such cases is obvious, but in many old houses a dining alcove of the type illustrated is equally valuable.

The older houses often have kitchens that are too large from the modern viewpoint, when experts count every footstep the housewife takes and when so many mechanical appliances and compact kitchen cabinets are



Fig. 1. Working details of this attractive breakfast nook are contained in Popular Science Monthly's Blueprint No. 33

used. In such a kitchen there is often a light, pleasant corner in which a dining alcove might be constructed to advantage by any man handy with woodworking tools.

The two designs illustrated can be adapted to suit almost any house, new or old. They were prepared especially for POPULAR SCIENCE MONTHLY by George F. Kaercher, an expert on furniture design, after long study of this type of built-in furniture. Consequently, they embody the latest ideas in construction.

### Adapted for Use in Any House

It is not essential that there should be an actual alcove or jog in the kitchen to take either of these dining-nooks; they can be placed in a corner or even against a plain wall. The design shown in Figs. 3 and 4 (the latter on page 129), being quite solid and substantial, is especially good against a plain wall, since it has the effect of creating an alcove. It is most effective if there is a window at the end of the table.

The design shown in Figs. 1 and 2 is of more open construction and is better adapted for use in a corner or recess. Each set consists of a simply made and very substantial table and two identical benches with high backs.

The bench of the design shown in Figs. 1 and 2 stands 3 ft. 6½ in. high over all, and is 4 ft. 6 in. long and 1 ft. 9 in. wide. The seat is the usual 18 in. above the floor. Neither these nor any of the following

dimensions have to be adhered to exactly, as some modification in the over-all sizes may be advisable to suit certain requirements, but on the average they represent the most practical proportions.

The stock to be used may be white pine, whitewood, cypress, chestnut, or any other easily worked wood.

The seats are 1½ by 20 in. by 4 ft. 6 in. The back legs, which run to within ½ in. of the top of the seat backs, are 1½ by 1½ in. by 3 ft. 3¼ in., four being required. Taper them back above the seat level as shown in Fig. 2. The front legs are 1½ by 1½ by 14½ in.

The legs are connected, as indicated, by means of a back rail 1½ by 2½ in. by 4 ft. ½ in. (one being required for each bench), a front rail 1½ by 2½ in. by 4 ft. 8 in., notched at the ends, and two end rails 1½ by 2½ by 18½ in., also notched.

The legs of each bench rest upon two base feet 1½ by 2½ by 20½ in. These feet are connected by two stretchers ¾ by 2½ in. by 4 ft., four being required. (Continued on page 129.)

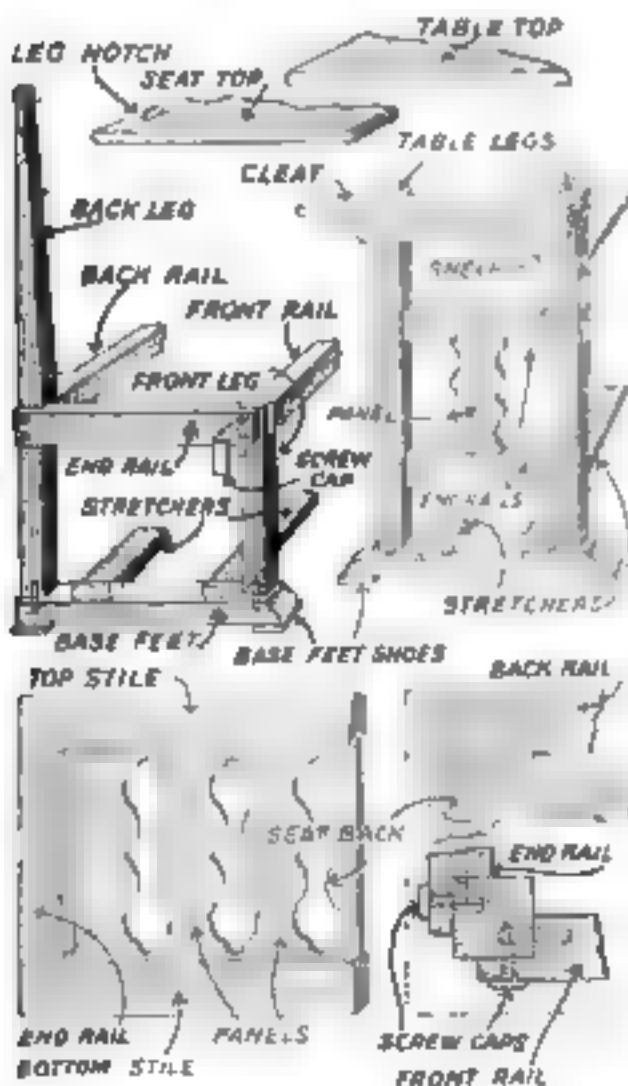


Fig. 2. How the parts of the table and benches shown in Fig. 1 are put together

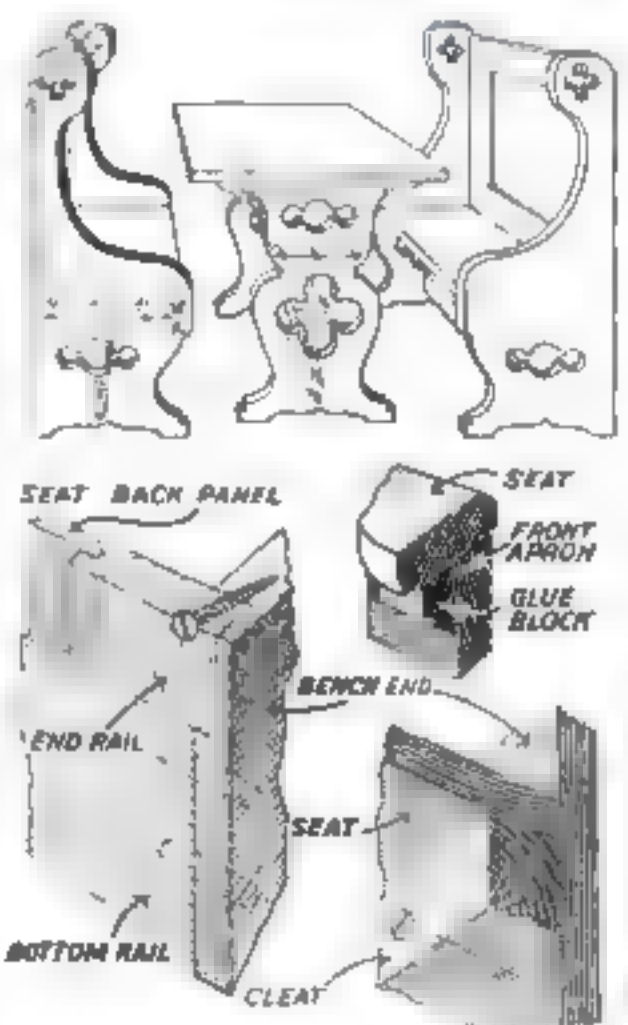


Fig. 3. Another decorative type of breakfast alcove with solid bench and table ends



# Attractive "Habitant" Chairs Are Built Easily

By Stanley W. Blanchard

UP IN Quebec, the home of the French-Canadian, the habitants still order their lives very much as did their fathers before them and, if need be, make their own furniture. It is one of these pieces of furniture, a chair (Fig. 1), that I shall describe.

Typically habitant, this chair is seen in many of the homesteads of the French-Canadian farmer and partakes of his virtues—it is strong, rugged, and durable. The marks of hand tools add rather than detract from the character of the piece.

These chairs have become popular with many who have seen them and are frequently used as porch furniture or in a dining or breakfast room when painted to match the color scheme.

The woodwork (Fig. 2) will offer no difficulties to the average amateur. Use straight-grained hard wood and good strong glue to hold it together. The

tires on their wagons in place of iron, some idea of its durability may be had. The seat also may be woven with strong cord or made of strips of soft flexible leather, 1 or 1½ in. wide, glued and tacked to the rungs and the strips woven

you leave the chair for very long, cover the seat with a damp cloth.

Take a position in front of the chair and mark lines on each top rung (Fig. 3) to show where the rawhide passes around the rung. The side and back rungs have 23 lines each and the front rung has 21 lines. Space the lines an equal distance apart and start and finish close to the leg at each end of the rung.

Now number the lines as shown. In this way any particular mark can be designated. Thus, the mark *L1* refers to the left rung, first mark, and *B13* refers to back rung, thirteenth mark.

Start the weaving at *L1*, fasten one end of a rawhide strip, stretch it across to *R1*, and loop around the rung (Fig. 4). Use this loop every time you pass a strip



Fig. 2. Side and front views of a typical "habitant" chair with essential dimensions

back legs may be cut from one plank to economize on lumber. The rungs may be ordinary ½-in. dowels, but it is more in keeping with the style of the chair to split the rungs yourself from a straight-grained piece of ash, leaving them slightly oversize and dressing to fit the holes where they enter the legs.

The slats in the back are mortised into the legs to a good depth, at least ½ in. The rungs are set completely through the legs and the ends planed flush after the glue is dry. Care must be used when boring the holes on the sides of the legs to allow for the fact that the chair is narrower in back than at front. The surest way is to make a wooden guide for the bit.

The seat is woven from rawhide or "babiche," as the habitant calls it. When you recall that the early Western pioneers successfully used rawhide for



Fig. 3. Diagram showing the seat of woven rawhide numbered to simplify the work

in simple "over and under" fashion, as shown at the bottom of Fig. 4.

Weaving a rawhide seat, however, is not as difficult as may appear at first glance, and any one who makes this chair and seats it with rawhide will have the satisfaction of knowing that he has made an exact replica of a real habitant chair.

First obtain a quantity of rawhide strips about 3/16 in. wide or get a hide and cut them yourself if you wish. Keep the strips wet all the time until the seating is completed. At any time that

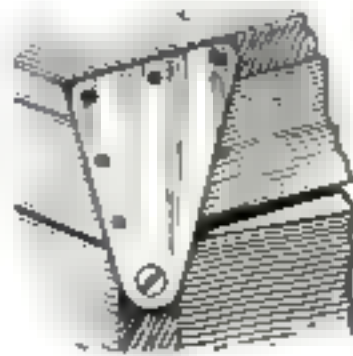
around a rung. From *R1* go to *B13* and then as follows: *B13* to *L2*—*R2*—*B13*—*F1*—*L3*—*R3*—*F2*—*R11*—*L4*—*R4*—*B14*—*F2*—*L5*—*R5*—*F20*—*B10*—*L6*—*R6*—*B15*—*F3*—*L7*—*R7*—*F19*—*B9*—*L8*—*R8*—*B16*—*F4*—*L9*—*R9*—*F18*—*B8*—*L10*—*R10*—*H17*—*F5*—*L11*—*R11*—*F17*—*B7*—*L12*—*R12*—*B18*—*F6*—*L13*—*R13*—*F16*—*B6*—*L14*—*R14*—*B19*—*F7*—*L15*—*R15*—*F15*—*B5*—*L16*—*R16*—*B20*—*F8*—*L17*—*R17*—*F14*—*B4*—*L18*—*R18*—*B21*—*F9*—*L19*—*R19*—*F13*—*B3*—*L20*—*R20*—*B22*—*F10*—*L21*—*R21*—*F12*—*B2*—*L22*—*R22*—*B23*—*F11*—*B1*—*L23*—*R23*, which is the end.

Weave carefully over and under as you go from one point to another; if this weaving is done correctly, a six-sided pattern will result. The last strip may be tied to the rung at *R23* and any surplus cut off.

After the rawhide is tight and dry, give it a few coats of shellac and stain or paint the woodwork as desired.

## Box Hinges Cut from Sheet Metal

ONE of the simplest box hinges that can be made in the home workshop is the illustrated one. It is made of two small pieces of brass, copper, tin, or other thin metal. The pieces are cut as shown or in any decorative shape that suits the work in hand, and are attached to the lid with escutcheon pins.

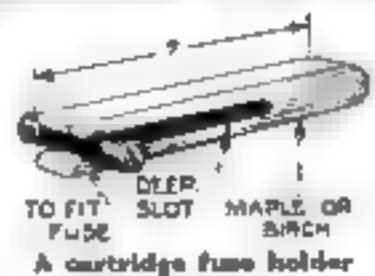


The pivot end of each piece is then fastened to the box with a round head wood screw.

Besides its simplicity and cheapness, this hinge has an advantage in very light work because it reinforces the lid where most necessary. Another advantage is that the lid can be turned well back without straining the hinges.

## Replacing Cartridge Fuses

TO AVOID the danger of shock and burns in removing and replacing cartridge fuses in a crowded electric panel board, it is worth while to use a holder made as shown.



A cartridge fuse holder

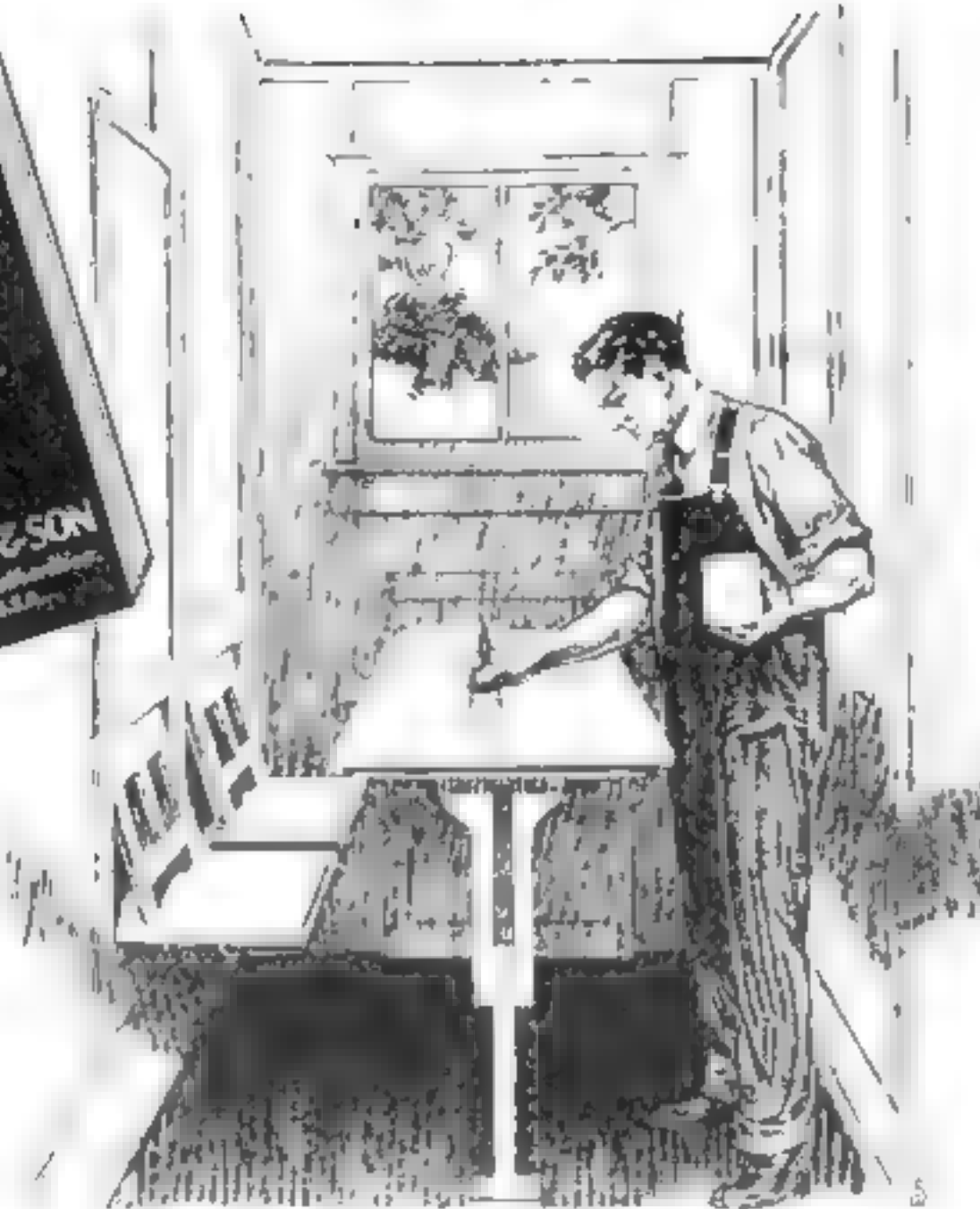
made as shown - WALTER T. MANNESKI



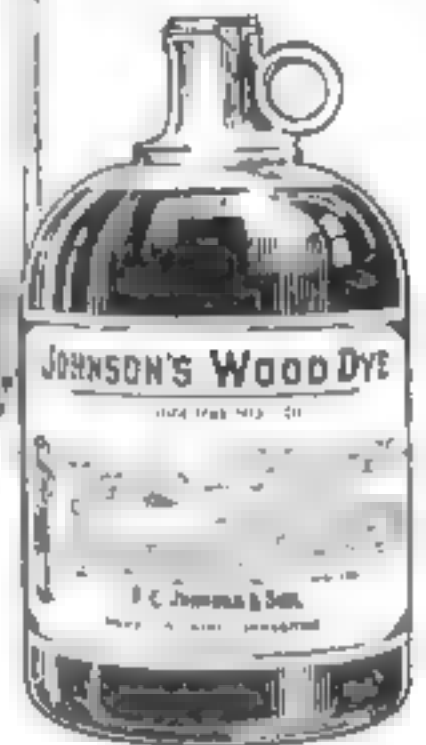
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# Tricks Every Woodworker Should Know

By Edwin M. Love

EVERY man sooner or later undertakes some woodwork repairs about his house or apartment. He may wish to build a wainscot of ceiling boards in his laundry room to protect plaster that has been weakened by the water continually seeping in. He may have to replace the picture molding or put more shelves in a clothes closet. In each instance there are "tricks of the trade," generally unknown to amateurs, by which a carpenter saves time in the work, and a few of these methods are explained below.

In putting down plain baseboard—the wooden guard that protects the wall from damage at the floor line—the simplest method of marking for cutting against a door casing is to use a so-called "preacher" or base hook. It is simply a wooden fork made as shown in Fig. 5 (for  $\frac{1}{4}$ -in. thick base). This is straddled over the boards, pressed against the back or outside edge of the casing, and marked down the front leg. A board so marked is usually long enough to allow a tightly pressed joint, which should fit on trial. Care should be taken not to cut the piece too long, however, as the pressure may force the jamb and cause the door to bind.

Having nailed the first piece of baseboard solidly, measure for the length of the second with two sticks, sliding one stick over the other, telescopic fashion, to make a rod of exactly the right length. Then mark and cut the board  $\frac{1}{4}$  in. longer to allow for scribing. Put the board in place as nearly as possible. Force the end to be cut against the wall and press it against its mating board in the corner. Then, holding a pair of dividers with legs  $\frac{1}{4}$  in. apart, as indicated in Fig. 4, draw steadily up from bottom to top, thus tracing a line exactly parallel to the face of the first board. This is, by the way, the general method used whenever it is necessary to fit, or, as a carpenter says, scribe a piece of wood to fit another irregular piece, or to go up against a plaster wall, which is almost certain to be more or less wavy or out of plumb.

## Cutting to the Scribed Line

Saw off the baseboard from the bottom edge to where the round edge begins at the top and finish the cut with a coping saw (often known to amateur woodworkers and manual-training boys as a fretsaw) to make a curved projection to fit the round on the other board. If by mischance the board is cut a trifle short, wedge from the other end, as this gap will be hidden behind the end of the board on the third side of the room.

Where a chimney or other projection jogs into the room, cut all the pieces necessary to go around, and tack in place; then,

if any fail to fit, they can be removed easily. Amateurs nearly always cut these mitered pieces too short, owing to the fact that the plaster usually slopes toward the corners. Having fitted one end of the first board to be mitered against its neighbor, hold it in place and mark the length

any scars in the surface will be covered. Verify by driving home a nail and then lay off distances of 16 in. both ways (as studs are usually 16 in. apart) to show where nails are to be driven.

Substantially the same method is followed in applying any flat bands, such as chair rails and wainscot caps.

In putting up picture molding, never enter the inside corners, as they always open up and look badly when the wood dries and shrinks. Instead, nail up pieces of molding on opposite ends of the room and cope the ends of the other two pieces (Fig. 5) to fit, cutting them slightly long so that the joints will squeeze tightly together.

To get the outline for coping, merely miter or cut the end of the molding at an angle of 45 degrees in a miter box. The sharp edge formed by the intersection of the cut with the molding's profile will give the line to be coped. It merely has to be followed around with a coping saw. All moldings can be coped for right angle joints in precisely the same way.

If, because of unevenness of the plaster, a picture molding joint remains open on the top, it often can be closed by driving a wedge behind the projecting lip of its mate (Fig. 5). Always undercut mitered joints sharply at the back, so that no wood at the back of the molding will prevent the front edges from closing.

Picture molding generally is put within  $\frac{1}{2}$  in. of the ceiling, a distance easily gauged with a small strip of wood. If it is to be any appreciable distance below the ceiling, the corner points should be located at equal distances from the ceiling and a chalk line struck between them to insure straightness in nailing up.

## Allowing for Misalignment

Should the window and door headers be much out of alignment, or the ceiling out of level, it is best to divide up the distances so that the molding will run approximately parallel. If it is run level with the cap molding on the door and window headers, replace the cap mold with molding of the same pattern as the picture mold, and cut the pieces on the wall to fit between the "returns" of the cap molding.

The small molding known as base shoe, which fills in the corner between the floor and the baseboard, is coped like picture molding and tacked against the floor and the baseboard. It is cut off square against the door casings, or, if it projects beyond the face of the casings, rounded slightly.

FEW homes are without a door or two that persistently binds or sticks. Mr. Love will tell the simplest methods for fixing doors in an article in next month's POPULAR SCIENCE MONTHLY.

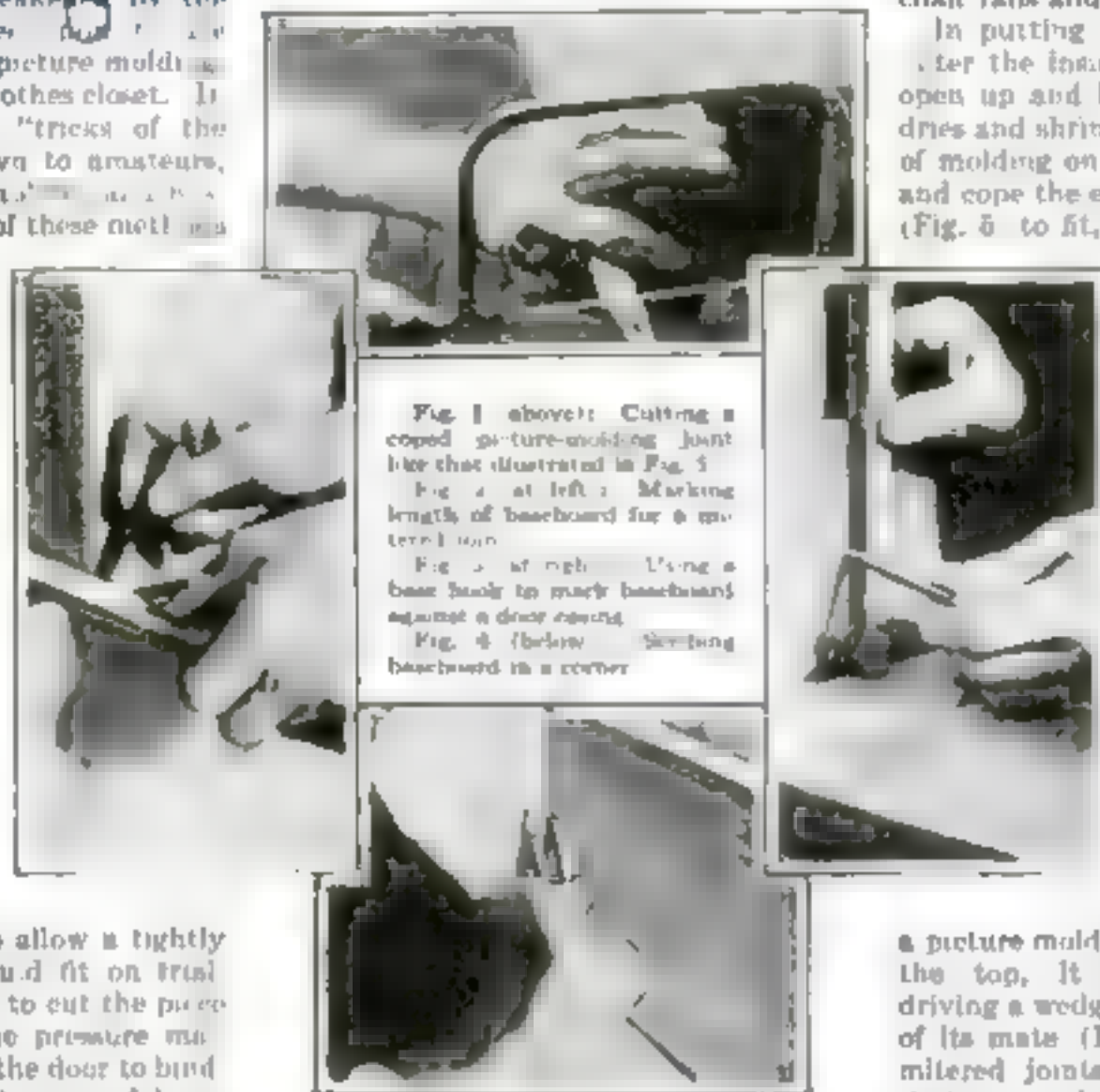


Fig. 1 above: Cutting a coped picture-molding joint like that illustrated in Fig. 5.

Fig. 2 at left: Marking length of baseboard for a mitered joint.

Fig. 3 at right: Using a base hook to mark baseboard against a door casing.

Fig. 4 below: Scribing baseboard in a corner.

with a straight edge held against the plaster, as in Fig. 2. This is the back of the miter, which is cut straight down the face; the plaster can be chipped out from below or the board blocked out, if necessary. Nail the joint from both directions with small finishing nails.

In nailing down base, locate a stud by sounding the plaster or wallboard with a hammer before placing the board, so that

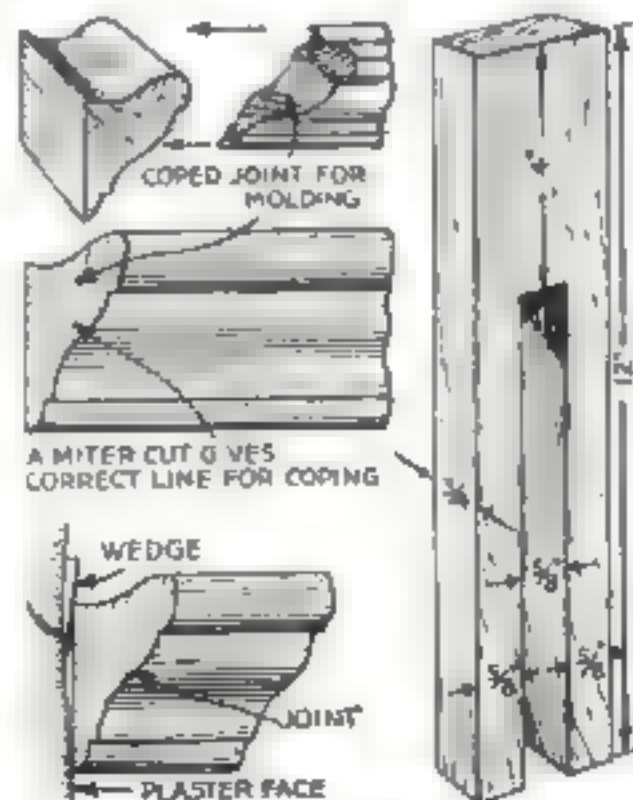


Fig. 5. How picture molding is mitered and coped, and detail of a base hook.



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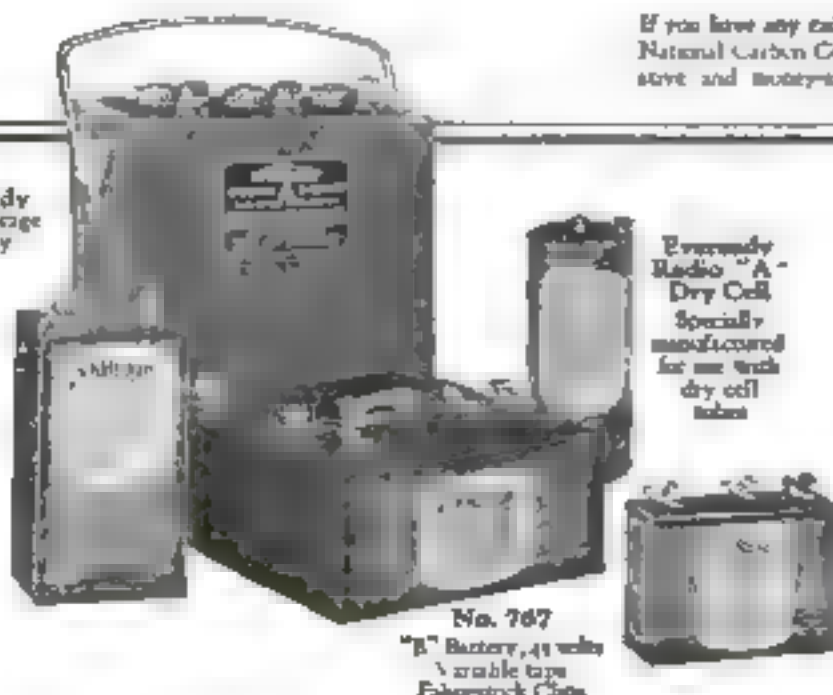
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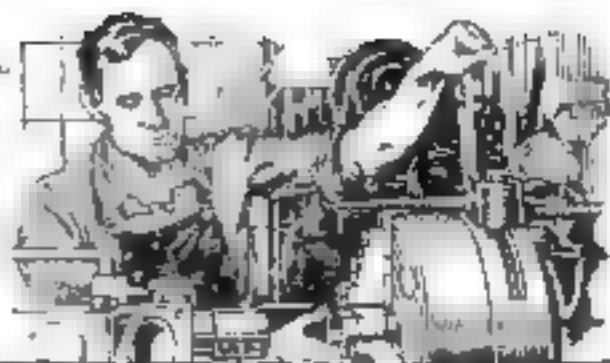
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# Better Shop Methods

How Expert Mechanics Save Time and Labor



## Some Secrets of Success in Hardening Steel

By J. A. Horton, M.E.

Designer of Rolling Mills and  
Special Machinery

**I**N HARDENING small tools and dies that have small projecting parts, the breakage is very great, and many ideas are suggested to prevent or reduce this loss. As a toolmaker and also a die-maker, I have tried many so-called hardening compounds and especially prepared water for this purpose, and have found the following to be for me the best and usually the easiest to find in the ordinary machine shop:

Take common hard soap, just what would be used to wash the hands with. Heat the tool or die very slowly and be careful not to allow any small, projecting parts to get too hot. If heated beyond a cherry red, the small part will have some of its carbon burned and this will impair the cutting quality and it will not keep sharp as long as the major portion of the tool or die.

### Daub with Hard Soap

Clean cold water should be at hand for quenching, but do not dip the tool as soon as it is heated. The small projecting parts, being thinner than the body, would cool too quickly and when the main parts cooled, the strain would be apt to crack the small part adjoining the body and it might drop off.

Instead, the small projecting parts are daubed with hard soap and then immediately immersed in the water before the gas generated from the soap has passed off. The water does not come into full contact with the steel until the gas is gone, and this keeps the small portion from getting too hard before the main body is hardened.

While in England a few years ago, where I had gone as consulting engineer supervising the construction of a mill, and later had become its superintendent, I had occasion to have a small forging hardened on both ends and softer in the middle.

This piece was about 3 in. long and 1 in. in diameter. When I asked the blacksmith to do this, he looked at it and said:

"If I heat one end and harden that, when I heat it to harden the other end it will draw the temper from the hardened end, and if I harden it all over, I cannot draw the temper in the middle without also drawing it from the ends."

I asked him to heat it and to allow me to dip it. A piece of soap lay on his forge. I had his cooling tub filled with clean water, and, when the forging was sufficiently

COULD YOU DO THIS?



**SUPPOSE** you had a small steel forging about 1 in. in diameter and 3 in. long and wished to harden it at both ends, leaving it soft in the middle. You needed the piece immediately and had only ordinary equipment to work with. Could you do it?

Mr Horton tells how he once astonished an old blacksmith by doing the trick, which is very simple and useful.

heated, I rubbed it around the middle with the soap and dipped immediately.

How he did laugh at me! But when the forging was cold, I handed it to him to make a file test. He found it much softer in the middle than at either end, just as I wished it to be.

The blacksmith remarked that he had been working at his trade for 30 years and had never seen soap used in

this way to keep steel from hardening.

As another illustration: Take a die on which a face is to be reproduced, with the nose quite prominent. As it is not practical to engrave into the depressed die, a hob is made the reverse of the die and it is then quite easy for the die engraver to give the desired expression to the face.

It now becomes necessary, however, to harden the hob so that it can be transferred to the actual die. I have seen a number that have had the nose broken off in the hardening process and, of course, the hob was lost; whereas, if the nose had been daubed with hard soap just previous to dipping in the water, the loss by breakage would have been lessened materially, if not prevented entirely.

In hardening dies of larger sizes, such as are used in a drop hammer—especially those that have a large amount of engraving and necessarily are expensive—the risk becomes a serious matter. The first impulse is to dip a die of this type quickly endwise into the water. It will come out looking pretty well but then may crack and be spoiled. Some experts use a special solution, especially iced brine, but still lose a large percentage.

### Treatment for Costly Dies

The writer has spent more than \$100 on a die and sent it to specialists whose process was to turn the die face down and bring up under it a stream of water for quenching purposes. The die came back cracked the whole length.

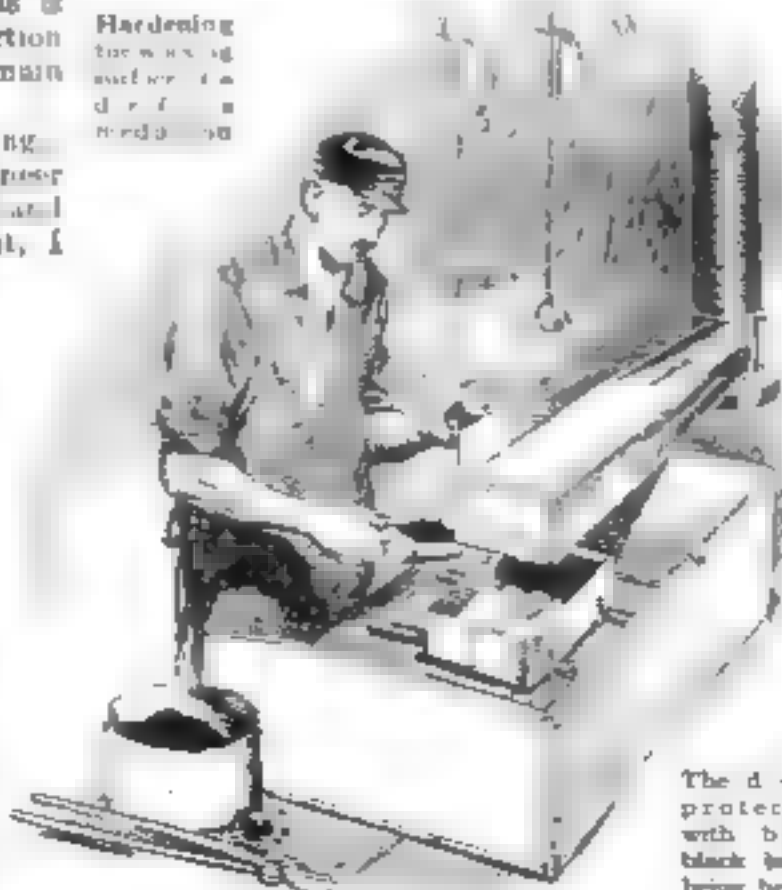
I experimented and found the following to be very satisfactory:

First, an engraved die must not be heated hot enough to harden in a furnace or fire where the atmosphere can reach it, as it will cause the finished engraving to oxidize and, when cooled, it will most likely scale and cause trouble in bringing back the polish. To avoid this, surround the die with an iron hoop projecting above the face surface of the die about  $\frac{1}{2}$  in., tight enough to stay up, but not so tight that it cannot be lifted off with a pair of tongs when hot. Now fill the box formed by the hoop with bone black to the level of the top of the band. This will keep the air from coming into contact with the face of the die while heating.

Prepare a box of suitable size, and take one side off to allow water to escape freely. Lay two pieces of iron pipe across the bottom on which to place the hot die and provide pins or nails to locate the die. Place the box, when complete, in a position convenient to a water supply.

(Continued on page 100)

Hardening the work by quenching in a water tub.



The die is protected with bone black before being heated.





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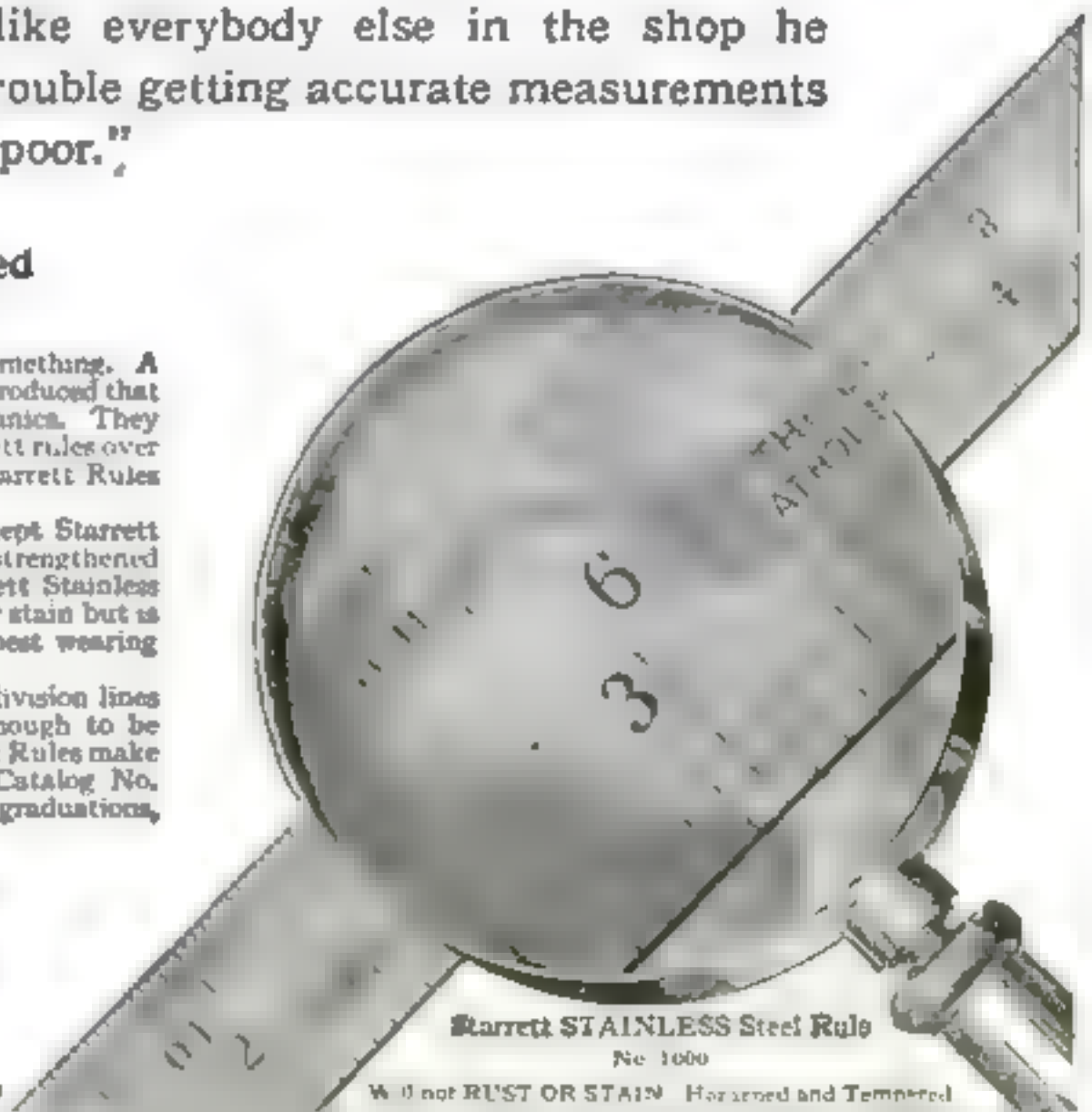
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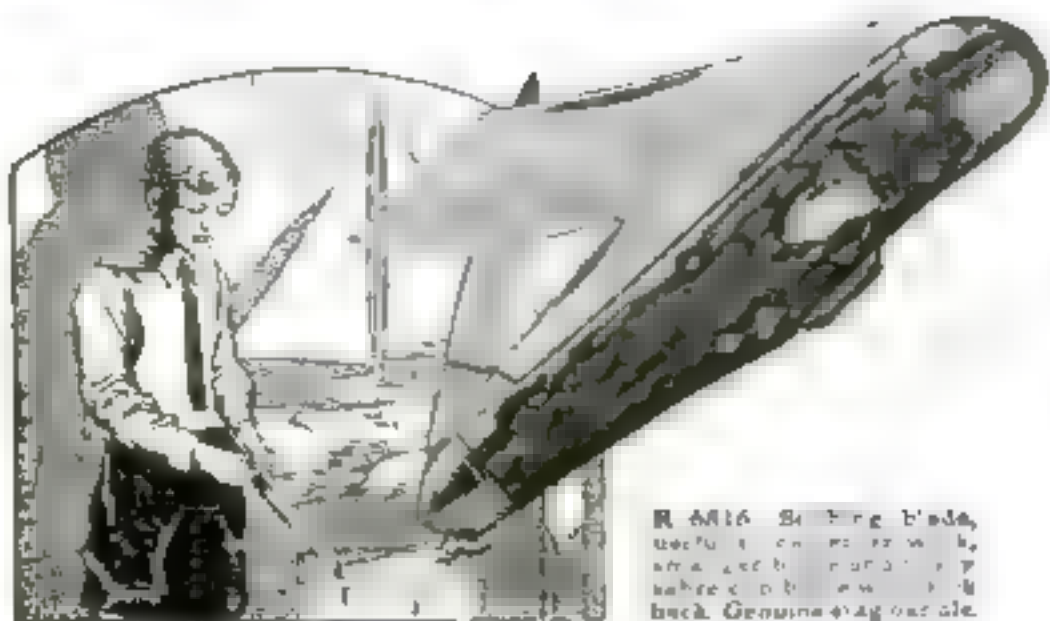


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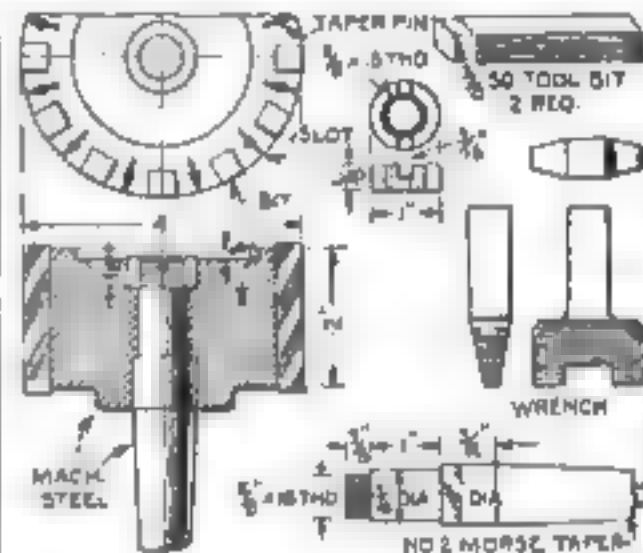
THE AUTHORITY IN FIRE ARMS, AMMUNITION AND CUTLERY  
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## Making an Inexpensive Face Mill with Inserted Teeth

**F**ACING cutters of large diameter are usually quite expensive. For small shop work the cutter here described will do the work about as well and can be made at perhaps half the cost of a purchased tool.

The body of this cutter and the shank are made from ordinary machine steel. The body first is turned all over as shown and taper pin holes then drilled and reamed. The reaming operation care must be taken to have all the holes the same depth.

The next operation on the body is cutting the slots through the centers of



Details of a shop-made face mill, in which the inserted teeth are held with taper pins.

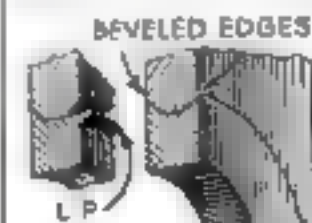
these holes to a sufficient depth to give spring to the intervening sections of metal. The taper pins, when driven home, will spring the two opposing sides together against the toolbits and hold them solidly in place.

The slots for the toolbits are milled out to fit the size steel to be used. For a 4-in. cutter a good size is  $\frac{3}{4}$ -in. square steel. The bits are cut to length and rough ground to shape. After this the assembled cutter should be set up on centers, either on a lathe or grinder, and carefully ground for clearance.

The wrench is forged from a piece of square stock and is simple and easy to make. The points should be case-hardened to give long wear and the mandrel nut also should be case-hardened.—H. W.

## Bushing a Circular Saw

**I**N EVERY woodworking shop are circular saws with bushings made necessary because the saws are used on small machines after they have been worn down



How the bushing is held in place.

or because they are used on other machines than those for which they were at first intended.

The best method I have found for holding a bushing in a saw, so that it will not be lost, is that illustrated. The eye or hole is countersunk on each side of the saw for one quarter the thickness of the saw, which may be done in a lathe or with a round file, and the bushing is then fitted as shown.—W. A. LYON, Plymouth, Wis.



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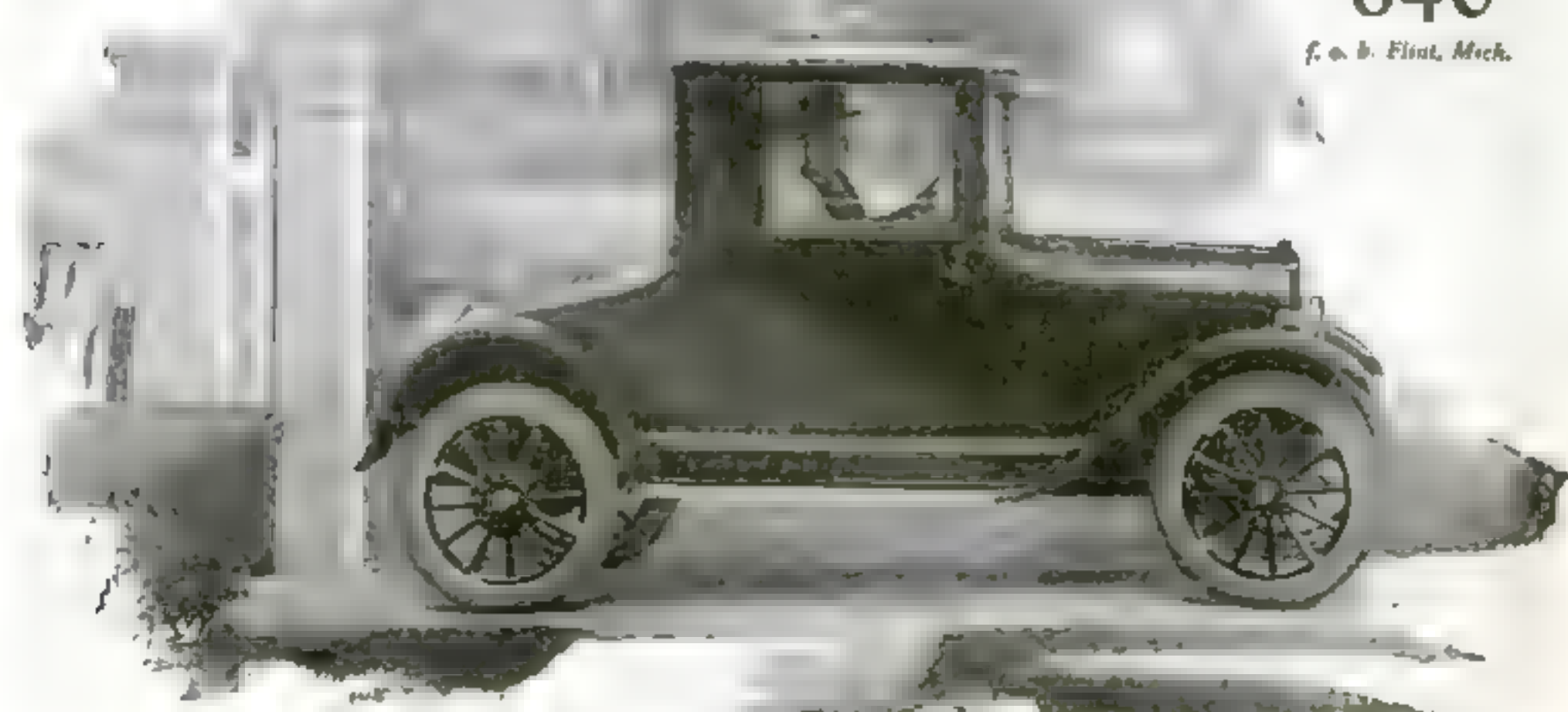
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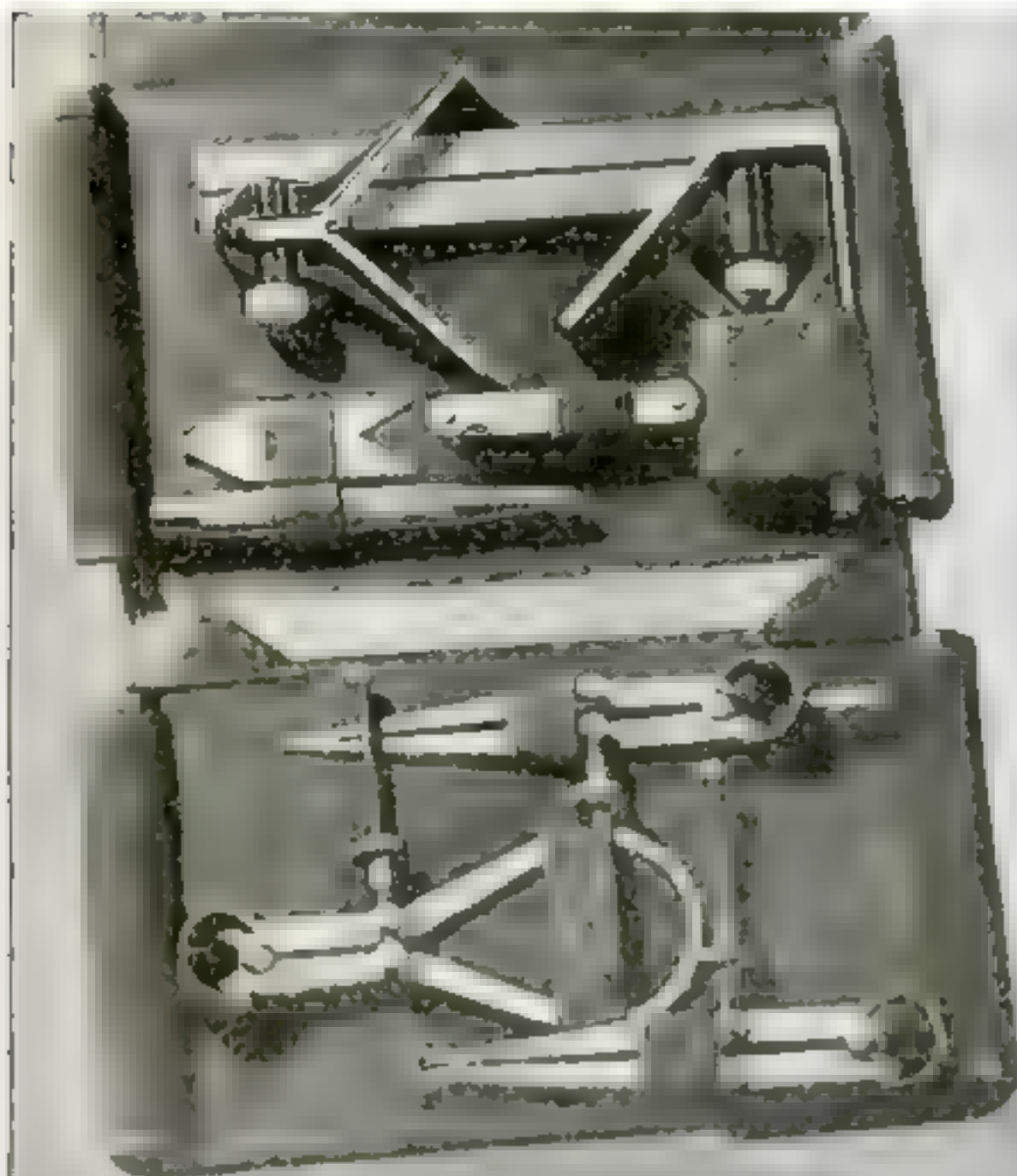
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## 1500 GOOD TOOLS

### Work-Holding Methods that Save a Machinist's Time

**M**ANY simple, time-saving suggestions for machinists are contained in this article, based upon shop ideas developed and used by F. J. Wilhelm, production manager of a Cincinnati firm manufacturing automobile accessories, and Joe V. Romig, machine tool designer and builder. If you are using other ingenious work-holding methods that have equally general application in the shop, send a letter describing them briefly to the Better Shop Methods Editor, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York. For those available for publication our usual rates will be paid.

"HAVEN'T you got that piston done yet?" called Old Bill to his assistant, who had been busy getting a piston ready on a lathe. Bill went over and found Joe just starting to cut the ring grooves, a job

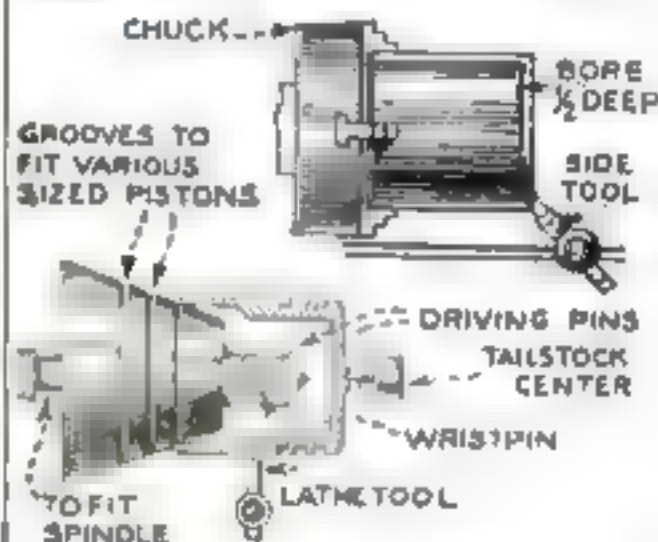


Fig. 1 Regular chuck used for first operation on piston, and mandrel for finishing cuts

that should have been done long ago. A glance showed what the trouble was. Joe had chucked the piston in such a way that the ring walls had been springing beyond salvage. Joe was a halfway mechanic who had never made a serious study of proper work-holding methods.

"Half the job is holding the work right," was Old Bill's comment, as he proceeded

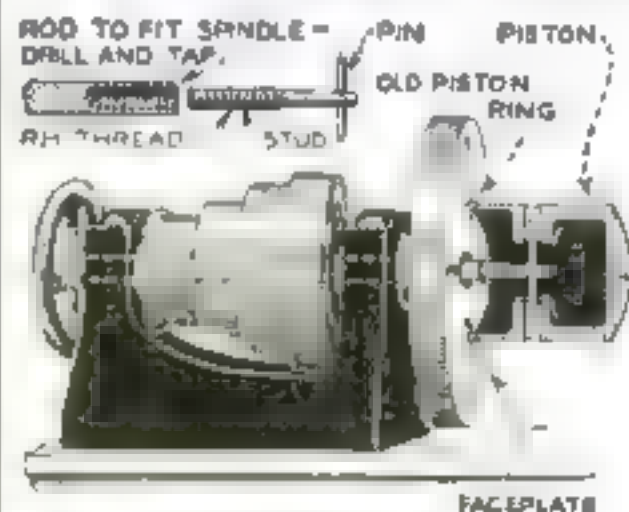


Fig. 2 Turning sandwhed draws piston against faceplate for roughing operations

to show his helper how the job should have been done in the first place.

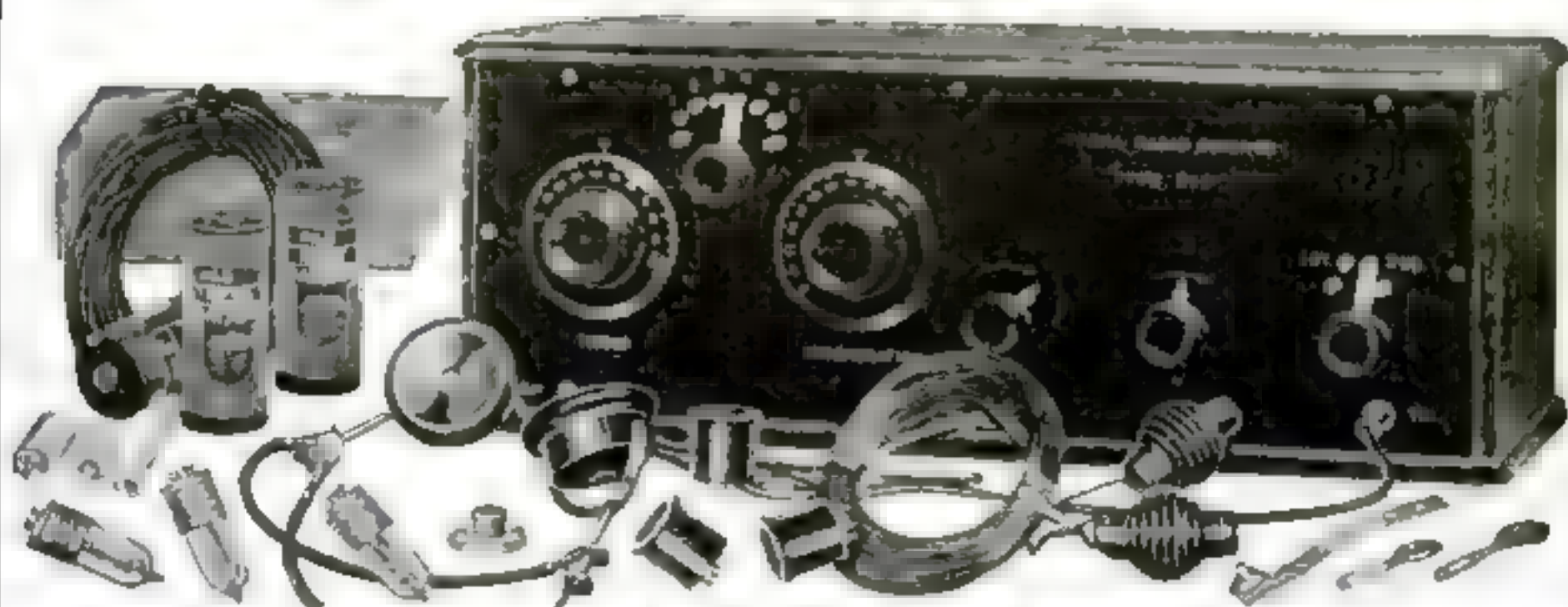
By the use of the right fixtures a piece of work can be held so there will be no springing or slipping, no damaged parts, and no waste time.

A piston casting may be placed in an ordinary chuck, as shown in Fig. 1, while

(Continued on page 92)



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WMAT	Duluth, Minn.
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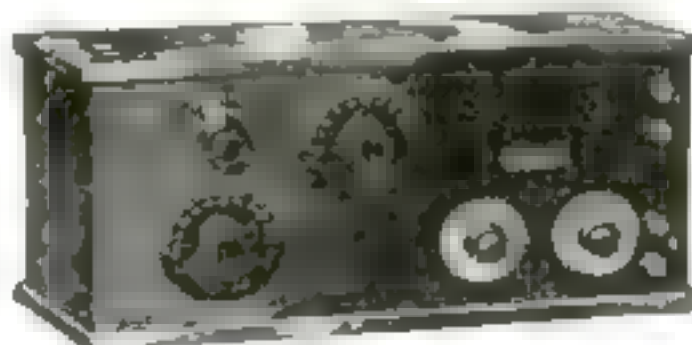
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# The Improved MIRACO

## Work-Holding Methods

(Continued from page 90)

the bottom of the skirt is faced off and the inside bored sufficiently to clean up the casting. A fixture then is made to hold the piston to the faceplate. It consists of a rod passing through the headstock spindle and a steel pin that slips through one end of the rod and bears against the wall of the wristpin hole in the piston (Fig. 2).

By turning the handwheel, which has a substantial shoulder bearing against the end of the lathe spindle, the finished face

of the piston is drawn tightly against the faceplate and held rigidly. The opposite end of the piston turns on the tailstock lathe center in the usual manner. There is no danger of loosening, since the fixture tends to draw the piston tighter. To allow the piston

WOOD BLOCK BOLTED TO FACE PLATE

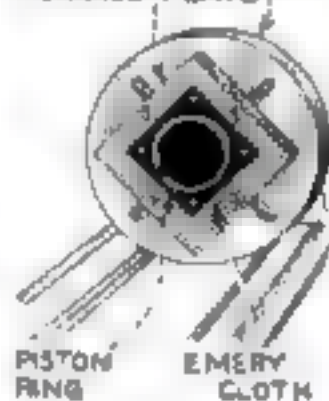


Fig. 3. Emery block for fitting piston rings

nearest the faceplate to be cut without marring the surface, an old piston ring is used for the purpose of the piston is indicated.

Another good method of holding such work is shown in Fig. 1. A mandrel is made with grooves that conform to the diameters of the various pieces to be turned. Pins in the end of the mandrel straddle the wristpin—in a piston job—and drive the work. This is a somewhat quicker method for finishing operations and when the piston is to be ground.

For fitting such parts as piston rings into grooves, the usual procedure is to lay the ring flat and file it. A simpler method is shown in Fig. 2. A piece of emery cloth is fastened to a block of wood, placed in the jaws of the lathe, and the ring is held against it.

After trimming down the lateral faces of a piston ring, so that it fits the groove, it is necessary only to file the joint ends, and this should be done with a file that has one flat side ground "safe."

The wristpin hole can be reamed with a reamer in tailstock chuck or by hand, the piston being held in a vise. A block should be placed between the skirt and the vise jaw so as not to damage the finished surface. The reamer must be kept true by keeping it parallel to the blade of a machinist's square placed on the piston.

A fixture for holding a piston while  
(Continued on page 94)

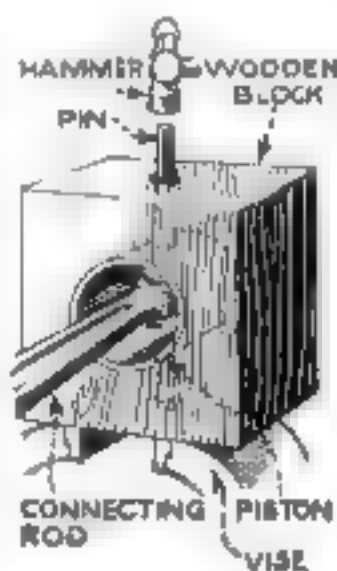


Fig. 4. Fixture for driving out wristpins





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# BROWN & SHARPE TOOLS

*"The Standard of the Mechanical World"*

## Work-Holding Methods

(Continued from page 92)

driving out a frozen wristpin or while reaming in a drill press is shown in Fig. 4.

While these work-holding fixtures can be made from scraps, they are far from makeshifts. They have proved quite satisfactory for a manufacturer who turns out pistons and connecting rods for racing cars.

Another phase of the work-holding question is the use of angle plates and supplementary tables.

Angle plates are subject to great strain and must be heavy and well braced. The most common type is made with two faces at right angles and has one or two 30-degree braces, as shown in Fig. 5. Plain angle plates are usually drilled for clamping bolts as may be needed. Some shops use plates with tapped  $\frac{1}{2}$ - or  $\frac{3}{4}$ -in. holes at horizontal and vertical lines, equally spaced. When holes are drilled

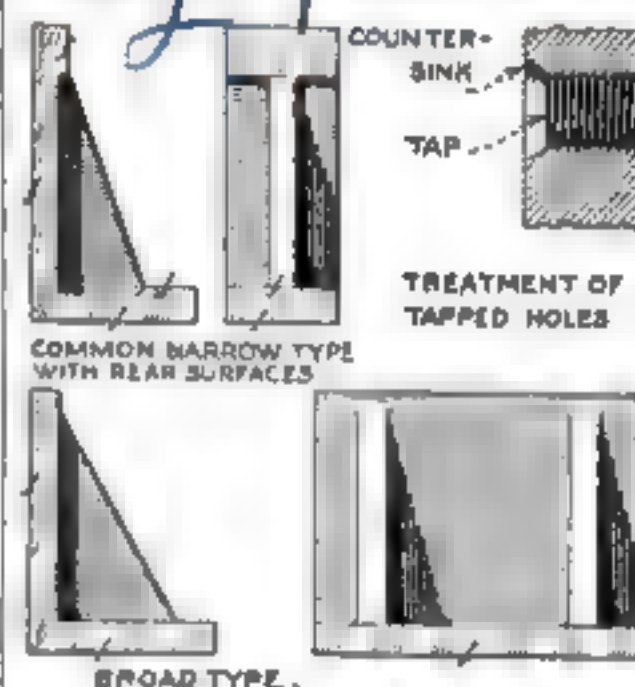


Fig. 5. Two types of angle plates, the upper one having accurately finished rear pads

for the use of studs, they should be countersunk first, as that makes it easier to tap the holes without turning up a burr that might hold the job off square.

A popular type of angle plate with toolmakers and machinery builders is the tall and narrow one shown in Fig. 5. This has machined pads on the reverse side of the faces and at the ends of the sides for making measurements and for square clamping. When the plates are to be used in the vertical position only, they sometimes are fitted with a slot in the base for a holding-down bolt.

A serviceable plate for the accurate machining of pipe fittings and fixtures is the combination box type shown in Fig. 6. It has two faces at right angles and a third at 45 degrees. This plate is open between the faces and is drilled with holes equally spaced so that bolts may be inserted from the inside or nuts be tightened from within. Box plates of this type vary from 8 in. to 4 ft. and larger.

Where work is to be machined while clamped in a vertical position, the tee-slotted plate is an excellent work-holding fixture. Slotted bases are the rule for this type—two slots for one bolt apiece or long slots in which two bolts can be placed.

Supplementary tables are used for work having staggered faces or faces

(Continued on page 96)



# Iver Johnson Rider

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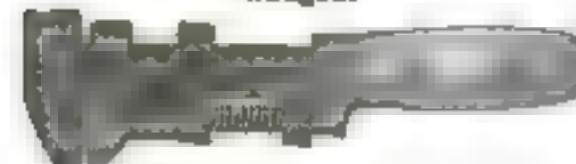
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WHEN a piston-rod is badly worn, it is practically impossible to keep a steamtight joint with ordinary packing methods. I have obtained excellent results by using hard brass rings about 1/16 in. thick and two thirds the width of the packing rings. The ends of each of these springy rings are 1/4 in. apart after they are placed over the packing. Cut the packing the proper length to go around a rod, place one of the brass rings over the packing ring and insert both into the packing box. Continue until the stuffing box is full. The packing will conform to the worn rod without excessive friction.—JAMES E. NOBLE.



### Work-Holding Methods

(Continued from page 94)

lying in two planes. Work having extensions that prevent it from being clamped flat to the worktable is held conveniently in such a table. When clamped to a planer or shaper table, the supplementary table will hold the work parallel to the machine table as well as square with it and it is more desirable than for a nap table or a wooden support for high work. Extra tables are made with one or two faces, as indicated in

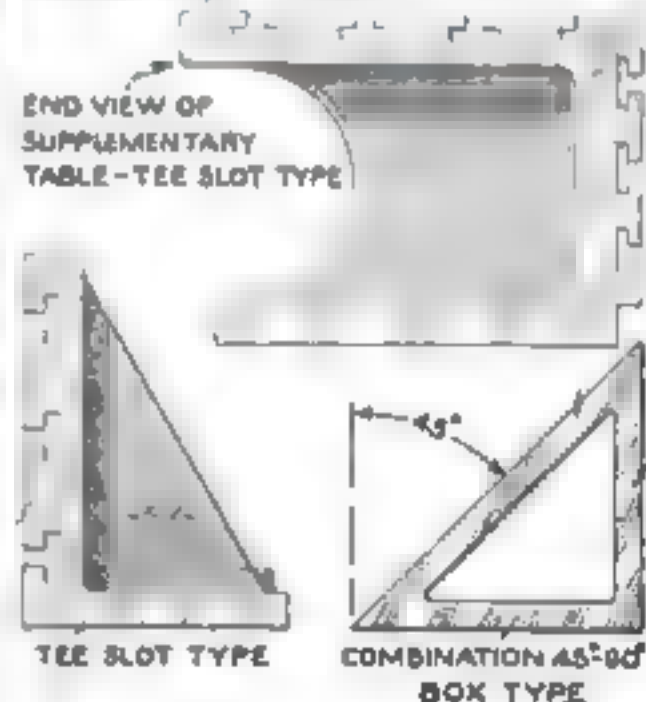


Fig. 4. Supplementary table for machines (above) and two types of angle plates below

Fig. 5. Two faces are the rule, although in some cases there is a broad flat-top face with two shorter side faces.

For special work, plates are made with odd angle faces and are, in general, to be preferred to the hinged or swiveling angle plate, as they are more rigid and do not shift under heavy cuts.

Cast iron is the ideal material for angle plates—it is easily machined and holds its shape well. Planing is the usual finishing operation, although small precision plates are ground.

A fine degree of accuracy is obtained on large plates by scraping to a master surface plate and using a master test square for the angular checking. All angle plates should be machined on their edges and these must be square and in line with the faces.





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### Simple Guide Fixture Saves Time in Tapping Nuts

**THIS** fixture is useful in shops where contract work is done, especially where nuts have to be manufactured in quantities. Machinists are well acquainted with the procedure of making nut blanks on the screw machine, either automatic or hand; this tool is for tapping the nuts after they are drilled and cut off the bar.

The machine used is either an engine lathe or a small hand-fed screw machine. The taper tap is as long as possible, up



When fed onto the tap, the nuts are kept from turning by hardened guides.

to a maximum of 20 in., depending on the size of the hole to be tapped. A tubular piece on the lathe center is used for starting the nuts on the tap. Two hardened guides in a guide channel are regulated with adjusting screws to fit the outside of the nuts.

It is apparent that by restraining the nuts from turning and by rotating the tap, the nuts are fed over the tap one by one as fast as they are entered at the point. They gradually run out of the shank of the tap, which is slightly smaller than the root diameter of the tap, and when the tap becomes full, it is removed from the chuck and the loose nuts are dropped off the end of the shank — W. B. H.

### Making a Heavy Plumb-Bob

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Heavy Plumb-Bob  
of 1 1/2-in. cold-rolled steel shaft, as shown. It weighs, when finished, about 10 lbs.



After the bob has been turned to the dimensions indicated, it is placed in a chuck and drilled and tapped for the plug. It is centered again and a hole is drilled through the plug for the plumb-line, which should be wire instead of cord. E. M. QUINCY

### COMING SHOP FEATURES

**WHAT** the Machinist Should Know about Punches and Dies, Making the Most of a Lathe, Saving the Cutting Edge on Planer Tools, How to Build a Small Turret Attachment for a Lathe, and Unusual Uses for a Drill Press.









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Please send me full particulars about the new Little Liberty Trunk.

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## Some Secrets of Hardening

(Continued from page 86)

ply that will have a 12-ft. head—a tank on the floor above is what I used. I bring a 4-in. pipe straight down over the die and couple directly on the end of this a length of tin or galvanized iron pipe. The tin pipe can be shaped roughly to the outline of the engraving on the die and arranged to stand about 4 in. above the die face. Have a clapper valve hinged inside the tank to cover the 4-in. opening and arranged to be opened by means of a cord within easy reach of the operator, so that he can open the valve wide or shut it

Now heat the die slowly and carefully to the desired heat say cherry red. Be careful not to disturb the bone black on the engraving. See to it that the corners of the die are heated. When hot place the die carefully on the pipe in the box and against the guide pins. See that the pipe is in position directly over the engraving. Remove the iron band without disturbing the bone black more than is necessary, pull the valve quickly, and hold it open until the die is cold. The water will carry the bone black away instantly.

### Reduces Chances of Cracking

It will be found to be hard only under the impact of the water, and the balance can be drilled and tapped to hold gages, thus avoiding the risk of cracking the corners if the holes are drilled beforehand.

With a little practice, I have been able to harden to a distance outside the figure of about  $\frac{1}{2}$  in. The balance is hardened slightly, but can easily be drilled and tapped for the gage screws. If the die does not sit steadily on the drop-hammer base, it can be placed on the bottom

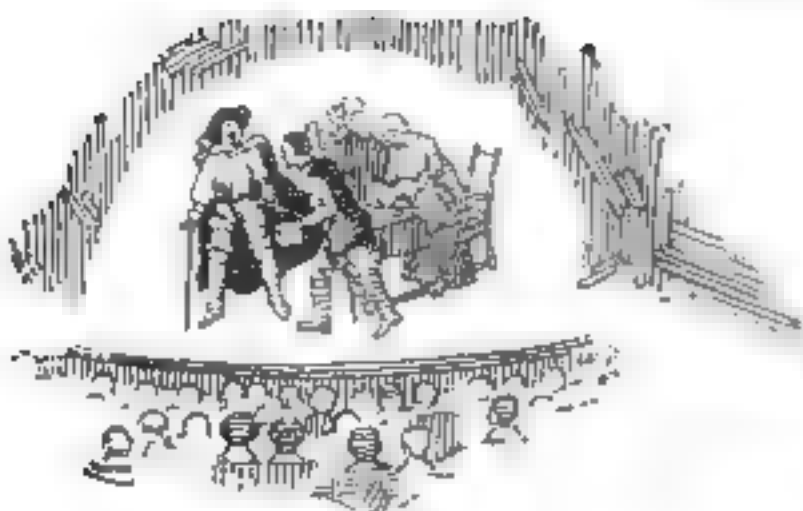
This may seem a considerable to-do to harden a die, but the outlay is suitable for many kinds of work. The only change is in the position of the guide pins and the shape of the first pattern section of the pipe, which is formed easily to suit the outline of the engraving. I have hardened a good many drop-hammer dies, and had no loss from cracking by this process.

By making a suitable cooling ring, it is quite possible to harden a grooved pulley, or similar article, all the way around in the bottom of the groove and leave the balance comparatively soft.

The die does not need to be drawn unless there are very delicate parts, which would be unusual for drop-hammer work.

WHEN Mr. Horton uses the term "cherry red" he is not implying, of course, that the now more or less obsolete method of judging heat by color should be followed, except in the absence of other means. Naturally, the heating by color is responsible for many of the failures of which he writes, as there may be a variation in from 200 to 400 degrees in what different mechanics would call a "cherry red." In order to place the emphasis solely upon his own interesting experiences in hardening, Mr. Horton has ignored side issues and it is to be taken for granted that electric pyrometers or temperature cones will be used when available in the heating of expensive tools and dies.





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## Cheaply Made Valve Grinder for the Small Garage

By Frank N. Conkley

UNTIL his work increases sufficiently to warrant the purchase of an expensive valve-grinding machine, the owner of a small garage can make at low cost a very satisfactory machine of his own, as illustrated.

A small hand-operated emery wheel is necessary. A good one can be obtained for about \$4.50, preferably one with a 6-in. wheel, although a smaller wheel will do. A 1-in. thick piece of steel plate 24 in. wide and 1 1/2 in. long serves as the base. This is cut, as indicated in Fig. 1, across one corner at an angle of 45 degrees. Two cap screws or bolts are used to fasten

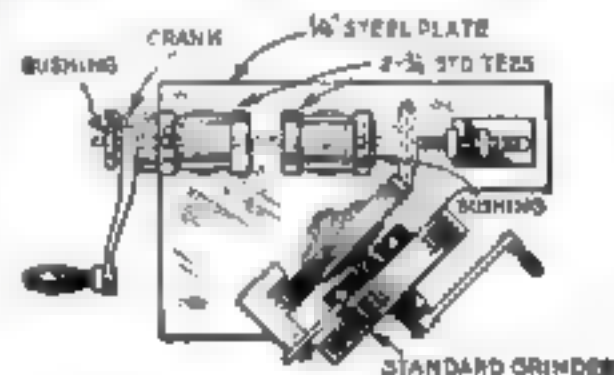


Fig. 1. Top view of the valve-grinding machine that utilizes a small tool grinder

the grinder in place. It is best to slot the holes, so that the grinder can be moved forward as the wheel wears down.

The height from the base plate to the center of the valve support is governed by the height of the grinder to the center of the wheel. The distances must correspond.

Two 3/4-in. tees and 2 short pieces of 1/4-in. pipe serve as bearings and uprights. A crank is used to rotate the valve. The threads in the outer ends of the tees are machined away.

The end of the crank hub is turned down to fit the pipe-tee and a groove machined in it to receive the end of a 1/2-in. setscrew (Fig. 2). The face side of the hub is tapped to receive a bushing. Two bushings in all are required and they should be bored a tight fit for the valve stem. For each size of valve rods handled, a separate pair of bushings will be required.

For feeding the valve to the wheel, a thumb screw with fine threads is used. This is held in position by a bracket and

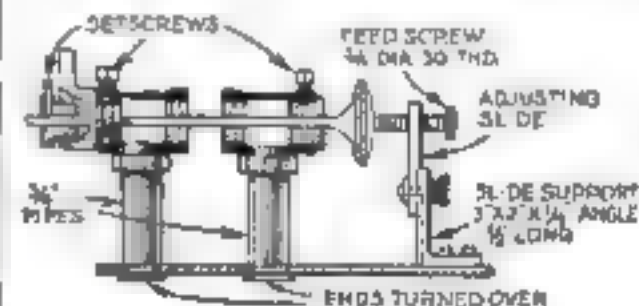


Fig. 2. The method of holding the valve stem, which is revolved by a hand crank

an adjustable slide. The bracket is made from a 1 1/2-in. length of 3 by 2 by 1/4 in. angle iron grooved on the face to allow the slide to be moved down when a valve is to be taken out or put in the machine.

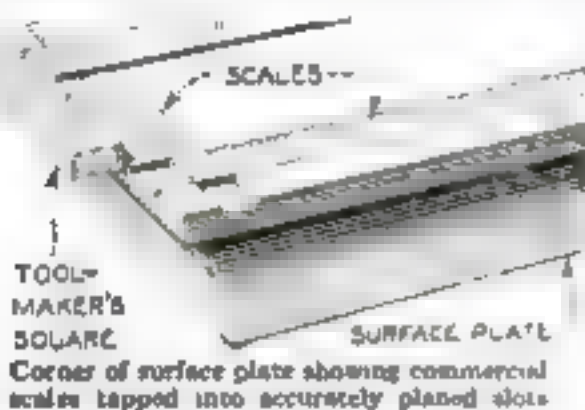
An advantage of this rig is that the grinder can be used for tool grinding when not required for grinding valves.



### Inserted Scales Give Added Usefulness to Surface Plate

A METHOD of improving the most important tool in the shop—the surface plate—is shown in the accompanying illustration. The word “important” is used advisedly, as all accuracy in dimensions must start from the surface plate.

A toolmaker's square is used against the left-hand edge of the conventional surface plate. If this edge is not finished, it should be. Then regular commercial

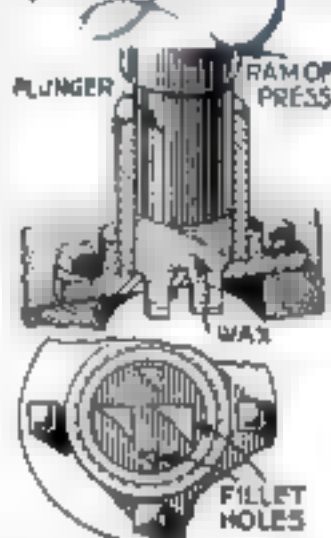


scales, with graduations suitable for the use to which the plate is to be put, are set into these plates, about  $\frac{1}{2}$  in. from the left and lower edges, as denoted. Plane clean, square-cornered grooves just wide enough to fit a good tapping bit for the scales, which are driven into place with a block of hard wood and a hammer.

The advantage of this arrangement is that a piece of work can be clamped on the surface plate and measurements transferred to it from two sides direct from the scale. If very fine tool work is being done, a Vernier slide may also be used. With the regular surface plate, measurements for comparison can be made only vertically or in one direction, but with a plate having scale inserts, measurements and layouts may be made in three directions or three planes.—W. BURR BENNETT.

### Wax Fillets for Pattern Work Made in Simple Press

READYMADE wax fillets for filling the square corners in patterns can be made in quantity by the use of the press illustrated. A plunger operating in a cylinder forces the warm wax through



orifices made in the bottom plate. These openings are the exact sizes of the fillets commonly required and are beveled upward toward the inside, so that the wax can flow freely.

A good wax mixture to use consists of 1 pt. linseed oil, 4 lbs. beeswax, 4 lbs. whiting and 1 lb. rosin. It becomes

hard when cold, can be glued to the patterns, and is practically unaffected by contact with moist sand.

Prepared fillets of this type save time over the familiar wax taper method, which requires more handwork.—G. A. L.

10 Shaves **FREE** See Coupon



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By V. K. Cassidy, Chief Chemist

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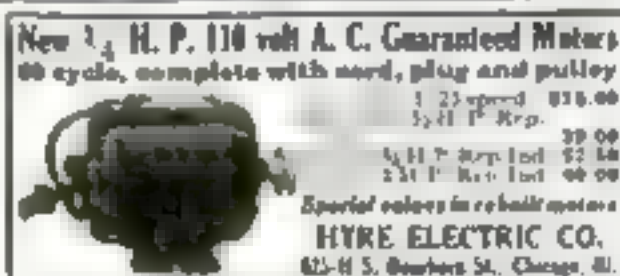
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## Simple V-Rest Fixture Aids in Grinding Center Punches

**T**O GRIND center punches and pivot rods accurately is a tedious job for almost any mechanic. For precision work even a minute deviation from the true center is not permissible. This makes it desirable to use some other method than



This holder keeps a punch or pivot rod at the right angle for grinding

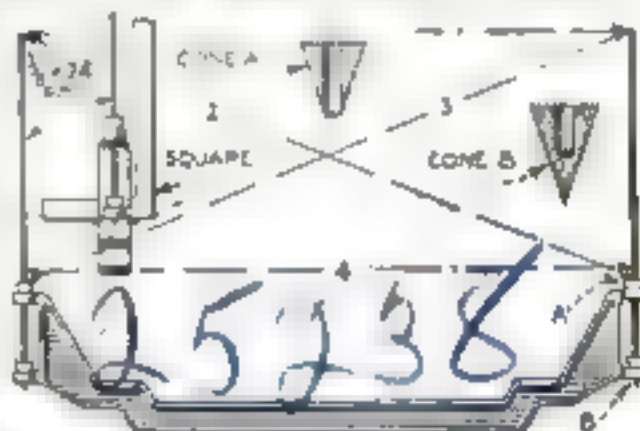
trying to center the punch or rod in a universal chuck.

An accurate job can be done by using a simple V-rest in conjunction with an ordinary grinder. The V-rest, made from flat steel, as shown, is fastened at an angle of 30 degrees with the face of the grinder. An adjustment screw at the lower end moves the work toward and away from the wheel. The point of this screw should bear against the center of the base of the tool or rod and this base must be perpendicular to the axis of the tool.

If the adjustment is properly made and the tool carefully turned in the rests, the point will be formed in the exact center of the punch.

## Cones and Rods Form Useful Gage for Testing Axles

**F**OR straightening automobile front axles, an accurate gage can be made quickly from four cones and two rods. The cones, which are turned and drilled as shown to receive the rods, should be about 2 in. in diameter at the base and 2 1/4 in. long, so that they will fit the average axle. Two of the cones are drilled completely



Checking the straightness of an automobile front axle with four cones and two rods

through and the other two only about 1 in. deep. The rods should be about 24 in. long and exactly alike.

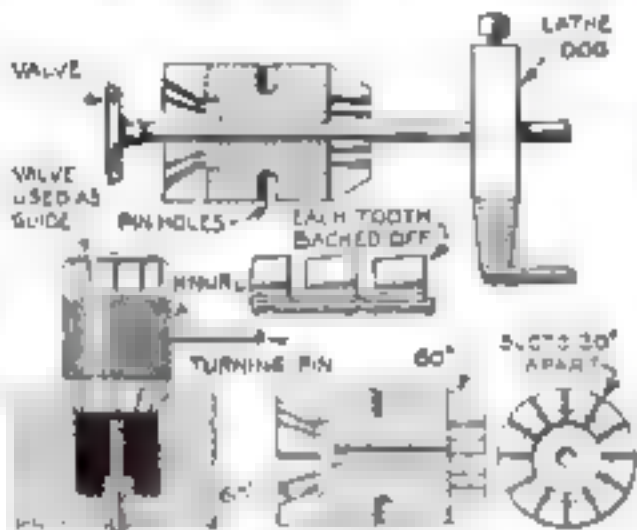
When the cones are placed in the axle, their axes conform with those of the holes. Therefore, when the rods are placed in position, they should be parallel if the axle is straight. Any error can be detected immediately by placing a square on the spring chair as indicated, and the parallelism of the rods can be checked by comparing the distances marked 1, 4, 2, and 8—O. W. MIELENZ, Philadelphia, Pa.



## One-Piece Tool for Refitting Engine Valves

**RESEATING** tools for engine valves frequently are more or less complicated. This simple tool, however, can be made from one piece with a lathe and a hacksaw or any power-driven saw.

The tool is of any grade steel that can be tempered. Its external diameter is somewhat larger than the valve. The piece is chucked in a lathe, the center is bored to fit the valve stem exactly, and the ends are cupped slightly to facilitate cutting the flutes. The ends are beveled, one externally and the other internally.



Details of the tool and method of using it for facing valves and valve seats

as indicated, at an angle of 60 degrees for standard use or otherwise to suit any special valve. The surface is knurled for the purposes of turning by hand and drilled with four holes to take a pin for use in heavy cutting.

Each end of the tool is slotted with wide slots about 30 degrees apart made by using two hacksaw blades in a holder. With a file these flutes are backed off to provide the cutting edges, which completes the tool up to the point of tempering.

To face a valve with the tool, the stem is passed through the hole and a clamp or lathe dog is placed on the stem to act as a handle for turning it. In cutting the seat in the block, the valve stem guides the tool.—G. A. LUENS

## Non-Slip Hammer Handle

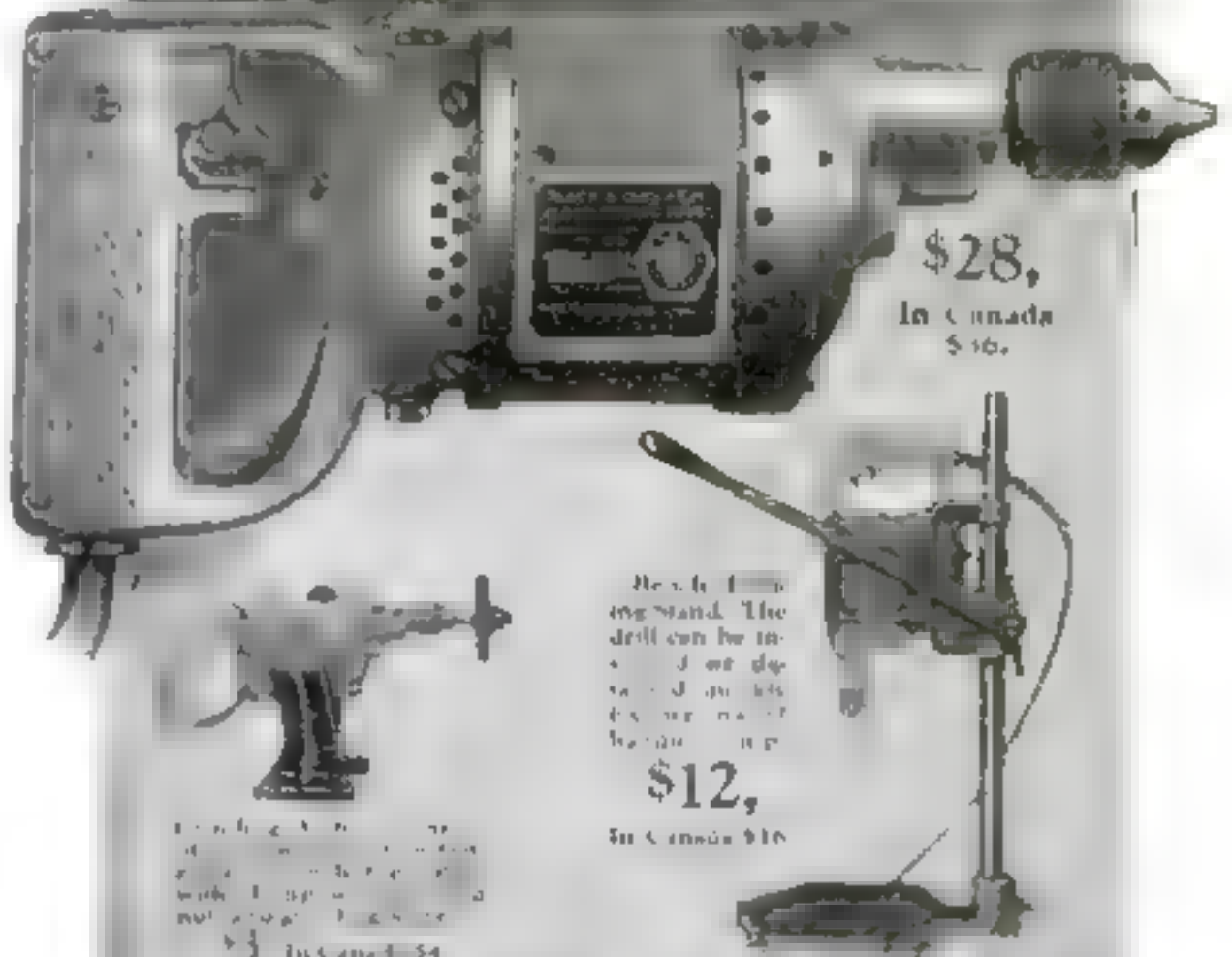
**THE** ordinary hammer handle becomes slippery when used on an oily or greasy job, but a handle prepared as shown will give good results.

To shape the handle in this way, first cover the inside of your right hand with a thin coat of Prussian blue. Grip the handle and strike several blows with the hammer. This will leave the prints of the fingers and thumb on the handle. With a knife and a round file cut away these marks, testing the handle from time to time.—JOHN AUBES, Buffalo, N. Y.

**DRAWINGS** and blueprints may be varnished before sending them out into the shop in the following manner: Dissolve gelatin in water and coat the drawing with this by means of a soft brush. After this coating has thoroughly dried, give the drawing a coat of clear varnish.

## BLACK & DECKER QUARTER-INCH PORTABLE ELECTRIC DRILL

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For many of these purposes, the drill is used in a very simple way. For example, to drill a hole in wood, you simply hold the drill against the wood and turn the handle. To drive a screw, you simply hold the drill against the screw and turn the handle.

For more difficult purposes, the drill is used in a more complicated way. For example, to grind a piece of metal, you simply hold the drill against the metal and turn the handle. To cut a piece of metal, you simply hold the drill against the metal and turn the handle.

For many other purposes, the drill is used in a very simple way. For example, to drill a hole in masonry, you simply hold the drill against the masonry and turn the handle. To drive a screw into masonry, you simply hold the drill against the screw and turn the handle.

For many other purposes, the drill is used in a very simple way. For example, to grind a piece of metal, you simply hold the drill against the metal and turn the handle. To cut a piece of metal, you simply hold the drill against the metal and turn the handle.

For many other purposes, the drill is used in a very simple way. For example, to drill a hole in wood, you simply hold the drill against the wood and turn the handle. To drive a screw into wood, you simply hold the drill against the screw and turn the handle.

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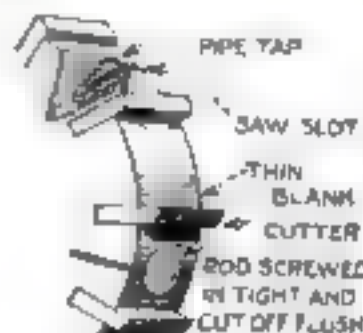
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motor



## Inserted Milling - Machine Cutters Held in Thin Blanks

**M**ILLING-MACHINE cutters sometimes have to be held in blanks that are too thin for the successful use of taper pins or screws and wedges. In such cases



This makes a substantial milling cutter

the blank may be drilled and tapped, as illustrated, with an ordinary pipe tap. After tapping, the holes are slotted with a hacksaw. A solid rod is threaded with a pipe die, screwed in as tight as possible,

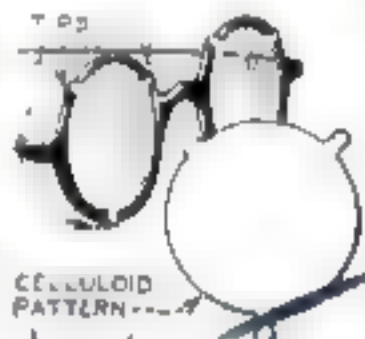
expanding the slot and cut off flush. If the cutters do not have to be changed often, worn out or broken, this makes a substantial tool. I have used the method on thin blanks after all other ideas had failed. —C. F.

## Celluloid Disks Protect Glasses from Emery Dust

**A**NY mechanic who uses glasses and works around emery wheels knows that fine pieces of emery are apt to stick in the lenses and ruin them. This can be prevented by making two transparent celluloid covers or protectors for the glasses, as illustrated.

These disks are cut from celluloid and two of the three small ears are bent over hook-like, while the third, which is somewhat longer, is shaped to form a small snap catch. They can be done by dipping the celluloid in hot water, bending the ears, holding them in shape, and dipping in ice water.

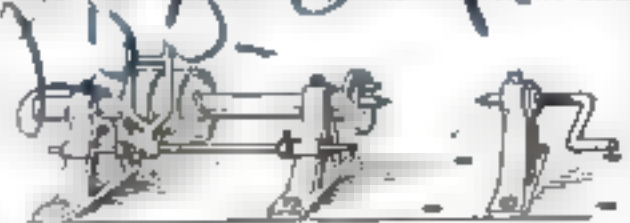
The same idea is useful when sun glasses are needed. No one can wear sun glasses over his regular glasses and feel comfortable, but if a pair of these covers are made from colored celluloid, they can be snapped over ordinary glasses.—E. G. HEADLEY, Parkersburg, W. Va.



The celluloid covers snap over the glasses

## Speed Lathe for Rough Use Made from Countershaft

**F**OR filing and polishing round stock, a lathe made as illustrated from an old countershaft is giving good service. The shaft was cut down to take the tight and



Costing little to build, this lathe serves for filing and polishing round stock

loose pulleys only, the cone being discarded. A hanger serves as the tailstock.



## Soldering Tongs Save Time in Making Electrical Splices

THE soldering of splices in electric wires is speeded up by use of the special tong-type soldering copper illustrated.

Unlike the usual taper-pointed copper, which is applied only to one side of the

COPPER BITS



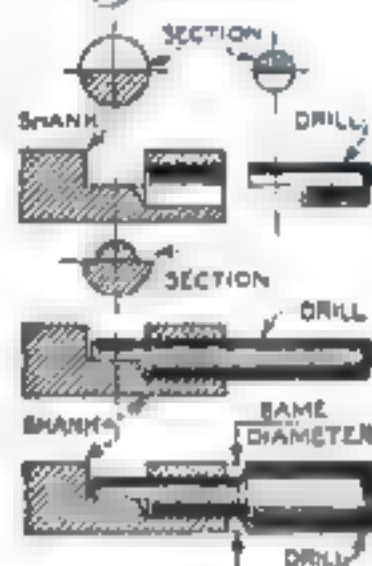
Pressed together over a splice, the double soldering bits quickly form a perfect joint

joint, this copper is in two sections, with jointed handles. It is clamped about the spliced wire and heats all sections, so that the solder flows uniformly and quickly into the joint.

A small flat spring of flexible steel is attached near the handles to separate the points automatically.—G. L.

## Extending Small Drills

TO INCREASE the length of small drills is frequently necessary. This can be done by fitting an extension piece to the shank of the drill, as illustrated. A hole the same diameter as the drill is



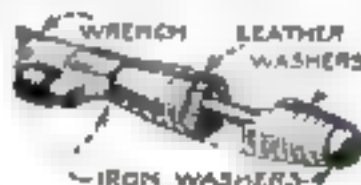
How drill and extension are joined

drilled in one end of the piece. Beyond this work hole the stock is cut down to the center line for a length of about one diameter. One half of the end of the drill is cut away also for a similar distance. The drill then can be driven firmly into the extension.

If the extension diameter must not exceed the drill diameter, it will be necessary to turn down the shank of the drill to about three-fourths of its original diameter before fitting it to the extension.—W. G. HOLMES.

## Leather Wrench Handle

THE round wooden handle found on some adjustable wrenches sometimes



cracks through accident or misuse. It can be replaced with washers made from rawhide or old leather, as depicted. This makes a good repair and gives a more comfortable grip, as the leather conforms more or less to the shape of the hand.—E. M. QUIMBY.

AN ARTICLE on unusual uses for a drill press is scheduled for early publication.

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Years after the ordinary truck would be worn out, GMC can still provide dependable, profitable service. As a matter of fact, it is impossible to estimate when GMC will wear out—it lasts indefinitely.

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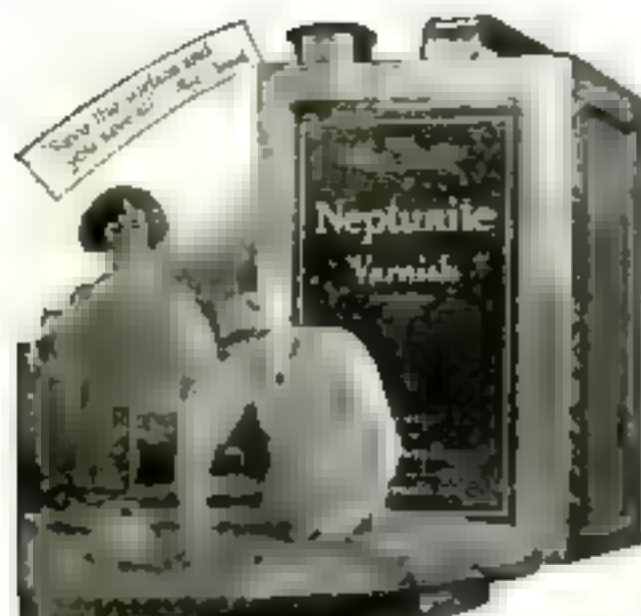
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PAINTS & VARNISHES

## Making a "Turned" Spiral Pedestal

By Gladstone Califf

**S**PIRALLY turned pedestals or legs are considered by *Superintendent of Schools, Richmond, Va.* 99 out of 100 home workers as being beyond the skill of any amateur mechanic without a lathe. Actually, however, they can be made with a few hand tools and some care.

It is surprising indeed what can be made in the home workshop. Figure 1 shows a pedestal turned on a lathe and Fig. 2 is one made entirely by hand with tools that every woodworker possesses. These represent a very old type of ornamentation that recently is enjoying renewed popularity. Generally speaking, it resembles a piece of rope twisted around a wooden rod.

To make a pedestal like Fig. 2, take a large old table leg—say a "four by four" if the latter is to be used, find the center of each end and draw circles to represent the top and bottom, the top being smaller. The piece is rounded by first planing it octagonal. This is

done by gaging two lines on each surface with the gage set to equal half the diagonal across the square end of the block. Then, judging with the eye, plane the 8 edges until there are 16 equal sides. Plane again until there are 32 sides. Then scrape the piece and round it with sandpaper. The tapering is done with a

spokeshave, your eye being the only guide.

The blank is held for working, as in Fig. 3.

For a 4-strand twist, as in Fig. 6, divide the circles at each end into 4 equal parts. Connect the points with straight lines and draw lines around the piece at any number of equal distances apart. The closer the lines are together, the tighter will be the twist. This division is made with dividers and the lines are drawn by wrapping a length of twine around the piece to serve as a guide for the pencil.

It is necessary to use the cord again to connect the various intersections in laying out the strands. This is done by selecting a point at one end and working from it, connecting the intersections diagonally one after another, as indicated in Fig. 8.

You are now ready to cut the strands. Saw a kerf or slot about  $\frac{1}{4}$  in. deep on each spiral mark going around the piece, as photographed in

Fig. 3. Then use a chisel and start cutting back about  $\frac{1}{4}$  in. from the lines, cutting each line from both sides (Fig. 4). You will have to use your own judgment in the depth of cutting; it may be necessary to saw a little deeper.

A wood rasp can be used in completing the strands and sandpaper for finishing.



Fig. 1. A lathe turned pedestal.



Fig. 2. Marking the depth of the strands with a back-saw.



Fig. 3. A blank piece of wood held for working.



Fig. 4. Rounding the twisted strands evenly with a chisel.

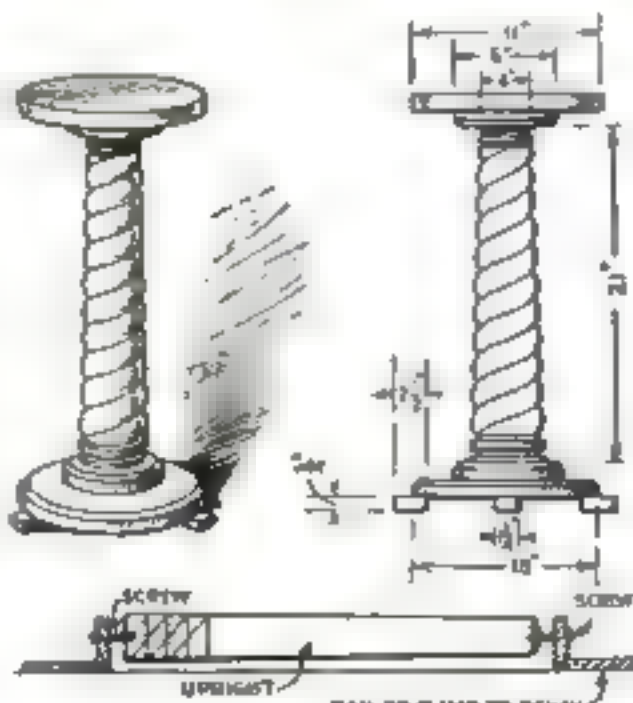


Fig. 5. Details of the stand shown in Fig. 2 above, and the method of holding the work.

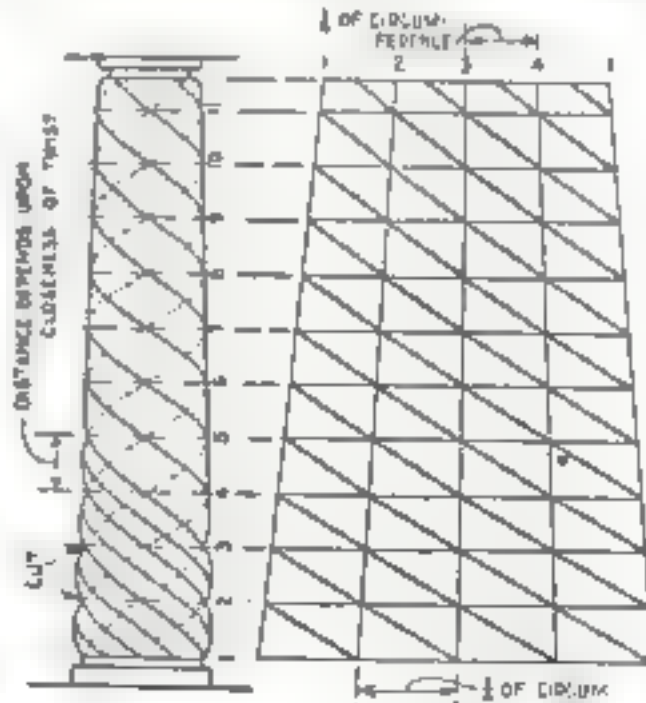


Fig. 6. How the pedestal is laid out at left, and diagram of the method at right.



## A Convenient Bench Is Essential in Any Home Workshop

**TO BUILD** an ideal home workshop bench is neither difficult nor expensive if the details of POPULAR SCIENCE MONTHLY's Blueprint No. 15 (listed below) are followed. That print was used



From POPULAR SCIENCE MONTHLY'S Blueprint No. 15; made for less than \$10

by E. Crass, of Paducah, Ky., in building the bench illustrated, and he writes as follows:

The cost of lumber did not exceed \$10 and if cheaper lumber had been used, the cost might have been as low as \$5 or \$6. The top and frame work are made of No. 1 seasoned oak at 10 cents a foot or about \$7 altogether. The drawer fronts are No. 1 dressed 1/2-in. pine. The back sides and bottom of the drawers are pine, dressed 1 in. or less, or crating. The back and sides of the bench and the hinges for the end lockers are thin three-ply veneer from a plywood plate procured at a local department store.

After the bench had been built, I gave it a good rubbing with fine sand paper and a good filler and then two coats of light floor varnish which gave it a nice finish.

I am highly pleased with my workbench and will say to any one who is interested that it is time, work, and money well spent and serves its purpose in every respect.

## Complete List of Blueprints

**ANY** one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

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Popular Science Monthly  
226 West 39th St., New York.

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3	Book Trough End Table	25c
4	Kitchen Cabinet	25c
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6	Shaving Cabinet	25c
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8	Porch Swing	25c
9	Bench and Tilt Top Table	25c
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13	Home Workshop Bench	25c
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15	Cedar and Mahogany Chest	25c
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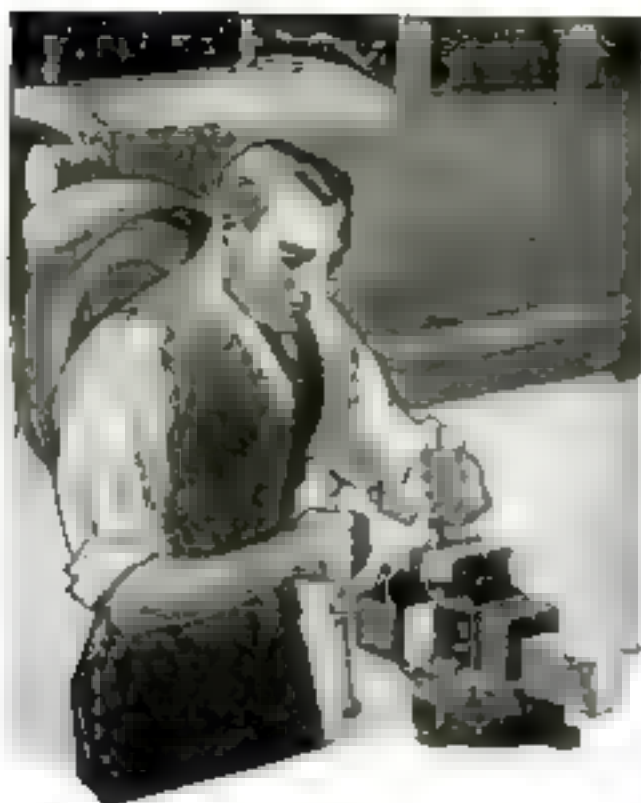
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## How to Build Ornamental Flower Boxes and Brackets

**FLOWER** boxes are becoming more and more a distinct architectural feature for the exterior of houses. They can be built with very little difficulty or expense and when properly painted add much to the appearance of the building. The boxes usually are set on brackets and placed below the first-floor windows or used on the porch or alongside the steps.

The first box illustrated in Fig. 1 is quite plain. It is simply nailed together

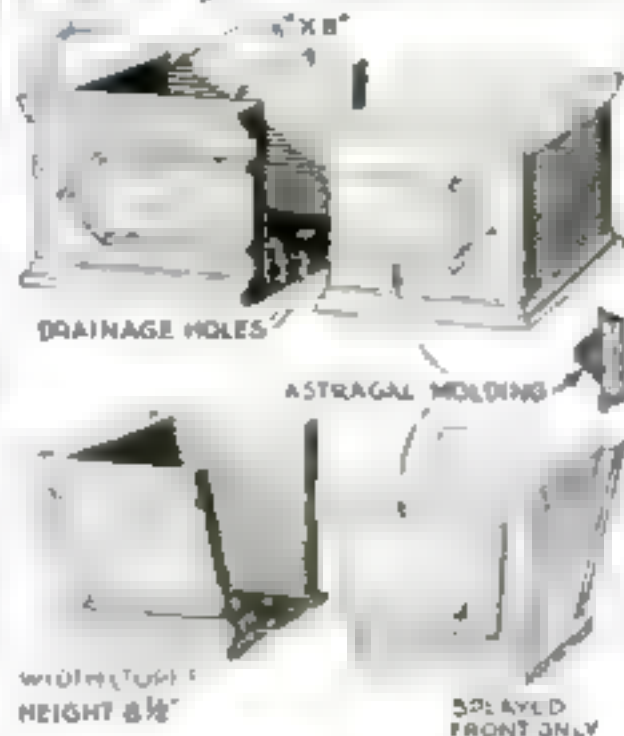


Fig. 1. Two types of easily made boxes that permit many individual variations in design.

and a molding is mitered around the top and bottom on the front and ends. The paneled effect can be added by nailing on an astragal molding or even a simple strip of lath. A great variety of panel designs may be made in this way.

The second box has splayed front and ends, the back is vertical. The sides and bottom project over the ends to relieve

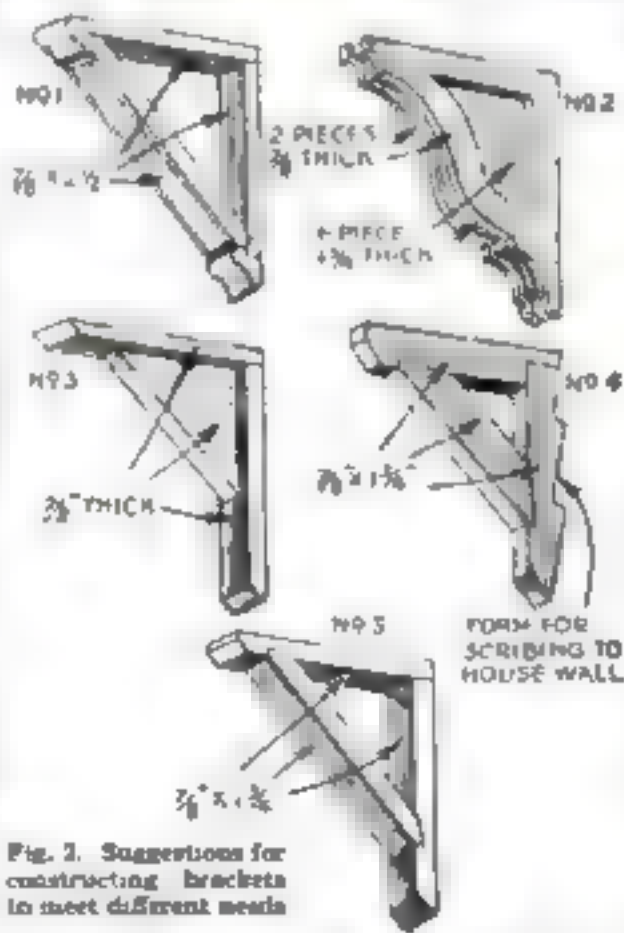


Fig. 2. Suggestions for constructing brackets to meet different needs.

the boxlike look. This box also may be made plain or paneled. It should be remembered that holes must be bored in the bottom of all flower boxes for drainage.

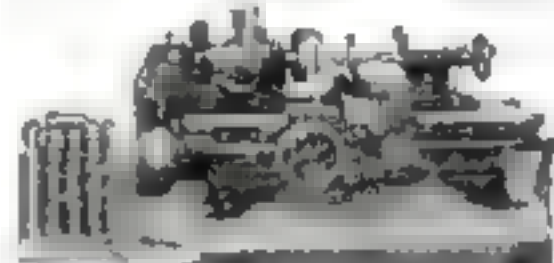
These boxes may be made of any  
(Continued on page 111)

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## Prices of Bench Lathes

SIZE	Quick Change	Standard Change
9" x 3'	\$231.00	\$201.00
11" x 4'	278.00	238.00
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Tool No. 12 has a fine knife blade and two standard blades. Tool No. 11 has a coarse and a fine blade. The handle of both tools is blued to prevent rust. A handle for fine work, handles, buy acids and for in use and use.

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## Colorful Lanterns Made of Cardboard and Paper

**O**RIGINAL lamps or lanterns that will rival the colorful and striking creations of professional decorators can be constructed in any home workshop with the simplest tools and materials.

The lantern consists of a cardboard frame with side openings filled with colored or patterned paper. The design,

Although inexpensive and easily made, this lantern has a rich and costly appearance.



which may be copied from advertisements, or developed from lamps seen in stores and elsewhere, is laid out in pencil on a large sheet of cardboard, cut out with a knife, bent to a square, octagonal or round shape, as the case may be, and fastened with glue or sewed. The bottom is made separately. It may be covered with gold or silver paper or coated with bronze or aluminum paint. Semitransparent oiled paper is then placed in the bottom and fixed against the side openings. The lantern conceals an ordinary electric drop-light and is suspended by chains or heavy silk cords.—H. S. T.

Methods for making parchment lamp-shade paper were described in an article, "How to Color Parchment Shades," on page 90 of our August, 1923, issue.

## Flower Boxes and Brackets

*Continued from page 110.*

reasonable length, but if more than 4 ft., at least three brackets should be used to support them. Five of the simpler flower-box wall brackets are shown in Fig. 2. In No. 1 the molding gives strength to the bracket, but it takes the place of scrollwork. All the parts must be nailed securely together in this, as in the other designs, so that the bracket will sustain a heavy weight. This bracket may be left open as indicated or a panel may be nailed in the triangular opening.

Number 2 is built up of three or four pieces. The two outside pieces are cut as shown, but the core, of one or two thicknesses, is cut only on the front edge, and is about 1/2 in. narrower than the outside pieces. This gives a paneled effect when all the parts are nailed together.

Number 3 is the simplest of all, but very strong; No. 4 is good construction for scribing to siding or shingles and No. 5 is easily nailed or bolted to the wall.—A. E. ELLING



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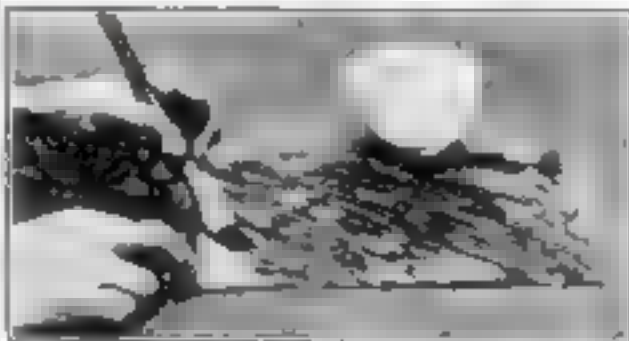
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## Ornamental Papers for Craft Work Made with Water Colors

ALMOST every home craftsman who does bookbinding or decorative work requiring what is commercially known as cover paper, has wished at some time or other for a method of making original ornamental papers with delicate and colorful designs. This can be done with surprising ease.

Dissolve half a teaspoonful of starch in half a glass of cold water. Pour half a pint of boiling water into a container and stir in the starch until the liquid is clear. Do not stir the starch when cold, water colors are used. Those intended for photographic prints are best, as they are



Blending colors with a brush and using a cardboard comb for a grained effect

bright and transparent, but artist's ordinary moist water colors will do very well. The starch is placed in smaller vessels and each container is colored with one of the tints to be used.

With a comparatively stiff brush, the color is brushed evenly on the paper to be decorated. Do not brush it out too thin. An interesting pattern or design can then be formed by drawing a few heavy lines through the stiff color with a pointed match, a piece of cardboard with a comb-like edge, or anything that suggests itself. Or take another color and, using the point of the brush, drag it over the paper with an up-and-down motion.

If the cardboard comb is drawn across the paper with a wavy motion diagonally, using two colors, the effect is often striking, as one color will merge into the other. Drawing a feather over the surface will produce designs somewhat resembling marble.—E. B.

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Write for our free diagram of standard circuit.

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## Handy Support for Sawing Is Hinged to Bench Legs

**T**O SAW off or rip a board is difficult unless it is properly supported, as on carpenter's saw horses. In my own home workshop, however, I have found that the saw bench illustrated serves the purpose



When not in use, the sawing support drops down out of the way.

very well and does not take up extra room.

A 12-in. wide board as long as the distance between the front legs of the bench is needed. Fasten it with two 6-in. strap hangers to the legs, and provide one or two short front legs for the board, about 1 by 3 by 18 in. When not in use, the board hangs down out of the way — **ROBERT L. WHITMAN, Miami, Fla.**

## Concrete Flower Pots



Stove-pipe set in concrete wall.

**W**HEN making concrete sides for small porch and steps, burn several stove-pipes vertically in the cement. These saved cement and provided openings that were used as flower pots. — **O. M. A.**

## Testing Dry Batteries

**F**OR testing dry cells, a 1½-volt miniature electric lamp is a fairly reliable guide. If it lights brightly, you may be sure you have a pretty good cell, while if it glows faintly, the cell is played out.

A neat way of mounting the bulb is illustrated. The case of a discarded dollar watch is used. Fasten a piece of hard fiber or wood with two or three small screws in the end opposite the stem.

On this block mount the essential parts of the miniature socket. Connect one terminal with the metal case and the other with a short piece of flexible cord brought out through the hollow stem. — **JAMES P. LEWIS, Golden, Colo.**



WOODEN OR FIBER BLOCK

Miniature lamp mounted in an old watch-case



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WHenever you can drill a hole, you can thread it with a "Yankee" Ratchet Tap Wrench.

The "Yankee" Ratchet and sliding cross-bar enable you to tap awkwardly located holes, close to walls, in tight corners. A finger-touch on the ratchet shifter gives right-hand, left-hand, or rigid adjustment.

Friction device holds sliding cross-bar central, or at either end. Knurled head makes it easy to start or back out taps quickly with the fingers.

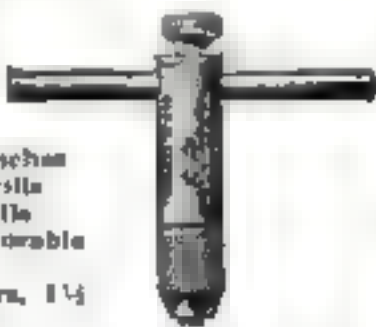
No. 250 (Illustrated) Chuck diam.  $\frac{3}{4}$  in. Capacity 1 1/16 in. taps. Length  $3\frac{1}{4}$  in.

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# "YANKEE" TOOLS

Make Better Mechanics

## How to Construct Apparatus for Magic Pendulum Trick

By Kenneth B. Murray

THE magic pendulum trick is a mystifying and entertaining stunt performed with apparatus any amateur mechanic can construct easily and cheaply.

On an ordinary table are placed a number of glass receptacles. In the center of the table is a wooden tee, from which are suspended pins or pendulums, one hanging inside each of the glasses. Sitting away from the table, the performer concentrates his gaze upon any pendulum selected by the spectators and causes it to quiver slowly, to gain momentum, and finally to swing back and forth and hit the sides of the glass. The

One of the pendulums is shown at the right and the entire visible apparatus. Below, The performer makes any given pendulum swing against the glass container.



other pendulums are slightly agitated, but they do not swing. At any time the spectators are allowed to examine the apparatus.

The cross is made of two 20-in. lengths of  $\frac{1}{4}$ -in. square wood and is set in a wooden block. The coins, preferably pennies, are glued to the cords, and the latter can be tied to the cross arm in view of the audience. This completes the visible apparatus, aside from the glass receptacles used.

The part not seen by the spectators is a length of rubber tubing and a bulb, such as is used with the shutter release of some cameras. The tubing should be more than 6 ft. long. To the end opposite the bulb is cemented a small, heavy rubber balloon. This outfit is placed under the rug or carpet, with the bulb under one leg of the table, which should be of light construction. Under the table leg next to this one should be placed a common button to help balance the table more easily. The operator has then merely to press on the rubber bulb with his foot to obtain an imperceptible movement of the table, which will start

(Continued on page 117)

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Conn Instruments speed your progress—insure success. Used and endorsed by world's great artists. Exclusive features, including the famous hydraulic expansion of tubing, make Conn—easy to play—beautiful in tone—perfect in scale—reliable in action—slide, valve or key—artistic design and finish.

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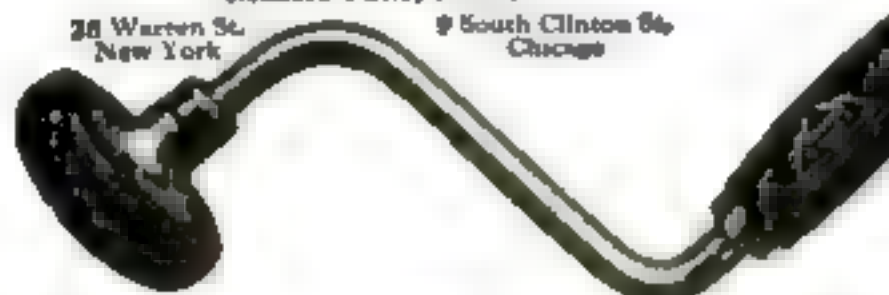
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## Home Workshop Chemistry

Simple Formulas that  
Will Save Time  
and Money



THE radio fan who takes pride in constructing as much of his apparatus as he can, will find it not at all difficult to make very efficient B batteries that not only have a long life, but also can be renewed again and again for a few cents when they run down. Each cell of the battery is a modified Daniell cell and gives approximately 1 volt. To give from 20 to 28 volts, 22 of the cells are used, the voltage depending upon the care taken in making each cell.

The containers are small glass tubes, in which photo developer had been contained. Almost every amateur photographer accumulates many of these. Those who do not do their own developing can



Inserting a zinc electrode in one cell of a partly finished battery (above) and adding plaster of Paris to a cell (at left)

obtain the tubes for the asking from friends who do photographic work. Two rows of holes, 11 holes to the row, are bored in a 1-in. thick board to take the tubes. Under this board another thin board is nailed.

The other materials necessary for the battery are copper sulphate, plaster of Paris, zinc, zinc sulphate, rubber insulated wire, and a little oil. A blowtorch or Bunsen burner for melting the zinc should be at hand, as well as a dry clay or sand mold for forming the zinc electrodes.

Take the rubber insulated wire, after removing any cotton or silk outer wrapper, and expose about 1 in. Bend this end into a circle to fit the bottom of the tube, and cut the wire off about 2 in. longer than the tube. Then bare 1 in. of the outside end. This is the positive pole of the cell.

Crush some copper sulphate and fill the tube one third full with it; then add a concentrated solution of copper sulphate until it is level with the crystals. A concentrated solution is made by dissolving as much of the chemical as possible in water.

Place some powdered plaster of Paris on top of the crystals, add a little water, (Continued on page 119)

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Standard of the World  
MADE FOR MOTOR OPERATOR  
14 Sizes of Bending  
When it comes to bend pipe or tubing, there is no other machine like this. It bends 1/2" to 2" pipe and 1/4" to 1" tubing. It bends 1/2" to 2" pipe and 1/4" to 1" tubing. It bends 1/2" to 2" pipe and 1/4" to 1" tubing.  
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## Home Workshop Chemistry

(Continued from page 118)

and then add a little more plaster and water until a membrane about  $\frac{1}{4}$  in. thick is formed. Let this stand until the plaster has set.

Meanwhile, melt some zinc and pour the molten mass into a mold. The shape of the mold is such that the casting will fill the tube for half its diameter and about a third its length. Just before pouring the molten zinc, a copper wire about 3 in. long and bare throughout its entire length, is placed near the top of the mold. The wire should be slightly hooked so that the molten zinc will grip it tightly and make an excellent electrical connection with it.

When the zinc electrode is cold, place it in the tube, the upper part of the tube having meanwhile been partly filled with a very dilute solution of zinc sulphate in water. One ounce of the salt is more than sufficient for 100 cells of this type.

When all the cells of the battery have been made in this manner, they are hooked up. This is accomplished by uniting the negative zinc pole of one cell to the positive copper pole of the other, and by connecting the negative of this one to the positive of the third cell, and so on. The connection may be made simply by connecting the wires together with brass nuts and bolts. Finally, one negative and one positive pole remain free. These are connected with the receiving set or with other 22-cell batteries of the same type.

The battery will give constant voltage until it is dead, and it is dead only after all the copper sulphate has been dissolved and plated or deposited on the positive wire electrode. It is well to cover the cells with a layer of oil to prevent evaporation. Then, too, it is advisable to renew the water, or solution of zinc sulphate when crystals make their appearance.

All that is necessary is to take a pipette or small glass tube and remove the liquid, or as much as possible, and add fresh water. Do not dissolve any zinc sulphate into the renewed water, as a sufficient quantity of this chemical will still be present in the cell to promote action and generate electricity.

The action that takes place is as follows: The copper sulphate plates out on the copper electrode; sulphuric acid becoming free, attacks the zinc; ions are set free and the zinc dissolves. This action takes place only when the battery is being used.

VARNISH that peeled has spoiled many a job. Test yours before using it by applying some to a thin sheet of metal, and bending the metal. Good varnish will stand the strain.

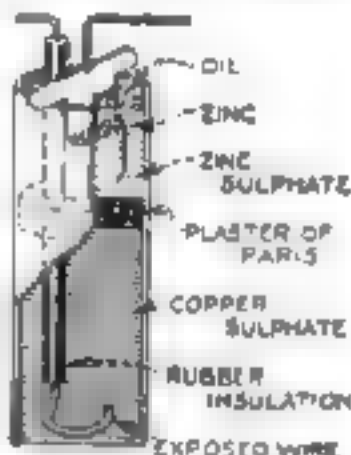


Diagram of one cell

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Socket Wrenches



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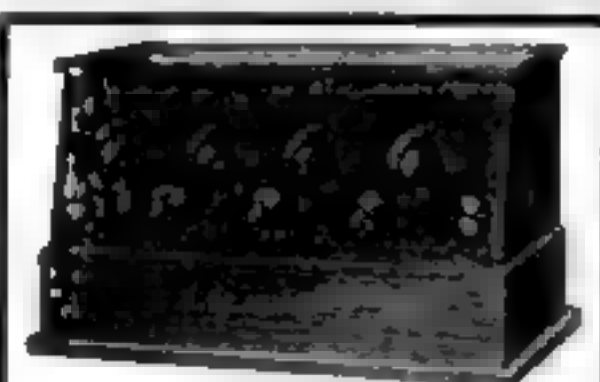
# Snap-on

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Liberty Custom Plate Top. It's a hot selling item, simple drive, easy finished, have a sign that says "We are independent of the state, state running and our own, we pay make or make: car. A making value. See all prospectus for Ford, Chevrolet, Chrysler and Plymouth. Write today for 14-page selling catalog.

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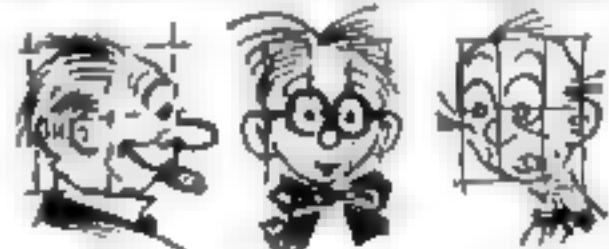
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The Course is NOT EXPENSIVE



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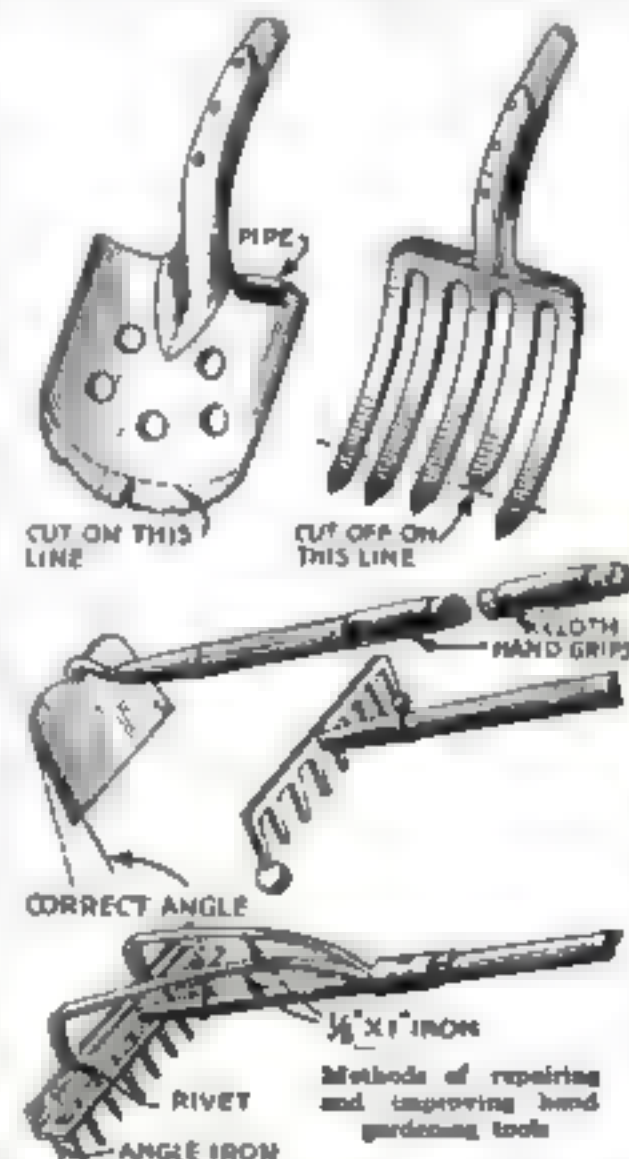
## How to Get Your Gardening Tools Ready for Spring

By Joe V. Romig

NOW is the time to get your gardening tools in shape for spring and summer.

Take your shovel, for instance. Is its edge badly bent and ragged, perhaps from trying to chop away ice from frozen sidewalks? Trim the edge well back of all cracks by cutting it away with a hammer and cold chisel, resting the shovel on a flat piece of iron or steel. Then dress it up with a file, and your shovel is almost as good as new.

An amateur gardener who do not wear heavy shoes are handicapped in spading by the sharpness of the upper edge of the shovel blade. To overcome this, a section of hose or gas-pipe is slit with a hacksaw and slipped over the edge, as shown. To prevent earth from sticking to the face of



the shovel, try drilling a few holes through it; this usually will cure the trouble. When the cross-hand grip of a spade splits, bind it with tire tape.

If a tooth of a garden spading fork breaks off, do not attempt to use it until you have sharpened it or have the remaining long teeth cut down to the length of the broken one.

The hoe is a much neglected and badly used tool. To make one cut the weeds readily, sharpen the bottom of the blade. Drilling a few holes will prevent the soft ground from caking on the face of the blade, but they must be spaced so as not to rob the blade of its strength.

The angle of the blade to the handle should be a little out of square, toeing in toward the under side. If your hoe works awkwardly, try bending it as indicated.

The rake is another tool put to many uses by the householder. He uses it for raking his garden, lawn and back yard.

(Continued on page 121)

## Old Town Canoes



## Push across to the bathing beach

DOWN by the wooded bank, a storm's throw from the cabin, an "Old Town Canoe" is moored. What a trim, graceful craft it is.

"Old Town" model is patterned after a real Indian canoe. "Old Towns" are light and steady. They are low in price too, \$64 up. From dealer or factory.

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Send for the MONARCH Lathe Catalog—fully illustrated—every type Engine Lathe up to 30 inches swing. Illustrated here is the MONARCH Jr. Lathe—an accurate compact, trouble proof Lathe for Inventors, Experimenters, Mechanics and Auto Repairmen. Fully equipped—semi-automatic change gear—auto safety devices.

**\$270**

9" to the 2" ft. bed—with bench legs

Also built with bed lengths up to 5 feet. Made in 11 inch swing size too, at slightly higher price.

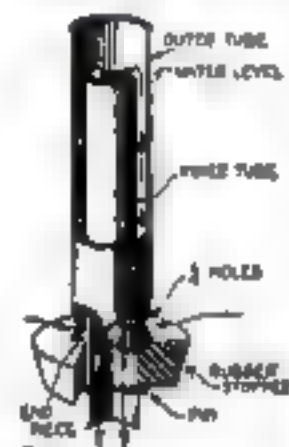
**THE MONARCH MACHINE TOOL CO.**  
401 Oak Street  
SIDNEY, Ohio



### Washing Photographic Prints

ANOTHER accessory for washing photographic prints along somewhat similar lines to that described by Mr. Schalek in the September, 1923, *POPULAR SCIENCE MONTHLY* is a drain plug as shown below.

A short length of  $\frac{1}{2}$ -in. brass tubing, with several  $\frac{1}{8}$ -in. holes drilled near the lower end and closed at the lower end with a piece of thin brass plate, through which a  $\frac{1}{4}$ -in. hole has been drilled. A length of  $\frac{1}{2}$ -in. tubing is slipped through this hole and soldered.



Drain plug for the photographer's sink

Obtain an ordinary rubber drain plug of a size to fit the sink drain, cut a hole in it, and push the end of the smaller tube through. A brass pin holds the tube in place. The heavier hypothesis is then always drawn off first. F. M. W., Jr.

### Your Gardening Tools

(Continued from page 120)

and it has to handle earth, straw, and litter of all kinds. Sometimes it serves as a snow-scraper in the winter after a piece of thin galvanized iron has been fastened to the teeth. The landscape gardener wires a piece of wood to the teeth to make a leveling scraper.

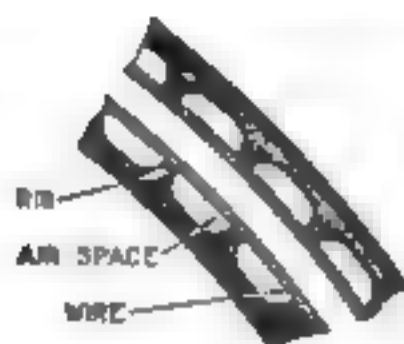
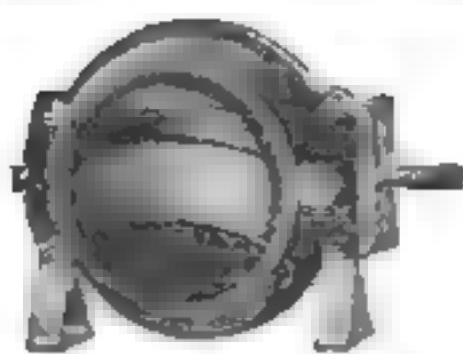
Like all other tools, the rake is apt to give trouble some time or other, usually when one attempts to rake up grass and leaves, which clog up the teeth. To facilitate their removal without stooping or using the hands, the rake should be fitted with a leaf remover made as illustrated.

A small piece of angle iron is drilled with holes spaced so as to slip loosely over the teeth. Attached to the upright leg of the angle is a holder made from  $\frac{1}{2}$  by 1 in. steel stock, bent, riveted, and screwed to the rake handle as shown. This holds the angle iron up against the top rail of the rake. To remove leaves and grass, the rake is turned over and hit on the ground, thus pushing the angle downward and clearing the teeth.

Wooden balls about 2 in. in diameter, when placed on each end tooth of a rake, act as runners and prevent the teeth from pulling out the grass. The balls are bored or drilled and pressed on the teeth to give the desired clearance. The taper of the teeth holds them in place.

Garden tools mainly have wooden handles and these become rough and weather checked. Old handles should be sandpapered and given a coat of good spar varnish. If treated the same way, new handles will wear twice as long and will not check at all.

Some of those who work in the garden only in the evening and after work, do not like the feel of bare wooden handles, yet do not like to wear working gloves. Canvas may be glued on the handle of any garden tool to afford a warm, comfortable, and firm grip.



## The Paragon Variometer No. 60

reduces dielectric losses to the minimum. It is the first variometer to combine coils surrounded by air with the mechanical strength necessary in such an instrument. It has no equal in the radio field.

Both stator and rotor forms are of polished black, moulded Condensate, each having 24 narrow raised ribs upon which windings are supported, thus practically surrounding them with air. This design, the result of eight years' experience, meets the rigid electrical requirements of PARAGON Receivers and fulfills the high mechanical standards of PARAGON parts. Price \$5.00.

Write for illustrated catalog of Paragon Radio Parts

ADAMS-MORGAN CO., 18 Alvin Avenue, Upper Montclair, N.J.

# PARAGON

Reg. U. S. Pat. Off.

## RADIO PRODUCTS

### For your home shop!

#### PARKS

Special Shop Special

**\$225**

with all attachments and motor

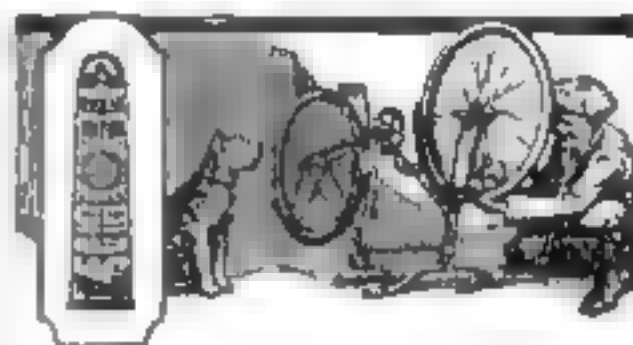


HERE'S an all-round woodworker for the small shop. Sturdy, fast and true. The biggest little woodworker ever built. Saw table has 8-in. rip and cross-cut saw, and 4-in. jointer and borer. You can choose from these extra attachments: band saw, shaper, sander, lathe, and motor. Send for Bulletin C-5 and complete Parks catalog.

The Parks Tool & Machine Company  
1847 Kiewit St., Cincinnati, O.  
Canadian Factory: 20 Lake Shore East, Montreal, Can.

# PARKS

WOODWORKING MACHINES



## Time to Overhaul The Old Bike

The first warm days will be here before you know it. Better look the old bike over now, so you will have it ready when the gang says "let's go."

Will you be out with the rest of them, or will a flat tire keep you home?

Get some Neverleak today, inject it in your tires and you won't have to worry about punctures all summer.

Neverleak comes in the yellow, green and white tube. Be sure you get the original. Price 25c at all bicycle and repair shops.

Buffalo Specialty Co., Buffalo, N. Y.

# NEVERLEAK

## TIRE FLUID

"HEALS PUNCTURES ON THE RUN."







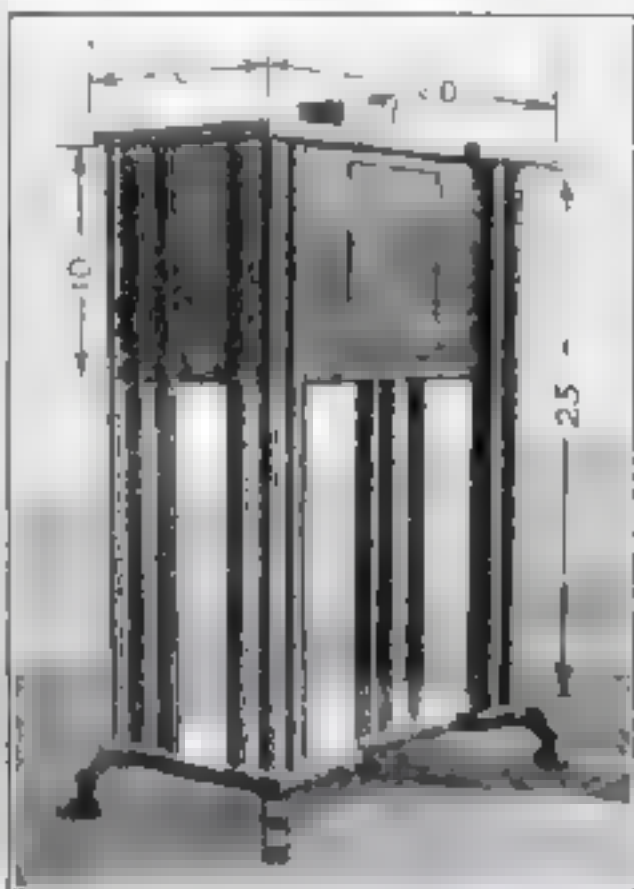
## Earn \$90 Building Four Simple Smoking Cabinets

ALTHOUGH not hard to make, the tobacco cabinet or humidor illustrated will grace any smoker's den or living-room. I have made three of these of quartered oak, for which I received \$20 each, and one of walnut, which brought \$30.

The stock required is

2 pieces, 1 by 10 by 20 in. for top and bottom  
12 pieces,  $\frac{3}{4}$  by  $\frac{3}{4}$  by 10 in. by 2 ft. 7 in. for legs  
2 pieces,  $\frac{3}{4}$  by  $\frac{3}{4}$  by 10 in. by 2 ft. 7 in. for top and bottom  
2 pieces,  $\frac{3}{4}$  by 10 by 15 in. for box sides  
1 piece,  $\frac{3}{4}$  by 8 by 6 in. for door  
1 piece,  $\frac{3}{4}$  by 6 by 15 in. for box bottom

First lay out and cut the top and bottom alike, as indicated. Make the box



One of the finished humidors, showing dimensions that have proved satisfactory

6 by 10 by 16 in. for top and bottom with mitered corners or ordinary butt joints. Leave the top open and make the bottom of solid material at hand. Cut the opening for the door and fit the door.

Next, cut mortises in the top and bottom boards  $\frac{3}{4}$  by  $\frac{3}{4}$  in. and  $\frac{1}{2}$  in. deep to take the legs, and also cut a groove or dado in the top board to take the upper edges of the box. Glue the box in first and then the legs.

Sandpaper the smoking cabinet inside and out. Then finish the inside of the box with white enamel and the exterior with stain and varnish to match the color of the other furniture in the room.—H. Scott, Sault Sainte Marie, Ont., Canada.

## Home Workshop Features

ARTICLES scheduled for early publication include: Novel Trellis Designs for the House and Garden. An Easy Way to Build Garage Doors. New Canvas Canoes from Old. How to Make a Buffet. A Homemade Shaper for the Amateur's Workshop. Building a Toy Motorboat. Attractive and Substantial "Habitant" Rocking Chairs. How to Fix Doors that Bind. A Novelty Trump Indicator, and Making Fire Extinguishers for the Home.

# \$25 for \$10

## The Famous Bel-Canto Acoustical Amplifier

Direct from Manufacturer to You!

**BEL-CANTO**

YOU cannot buy the Bel-Canto through any dealer only direct from us. We save you these three profits—Distributor, Jobber and Dealer.

Sent prepaid to any part of U. S. and Possessions

**PRICE \$10**

## Bel-Canto Mfg. Co.

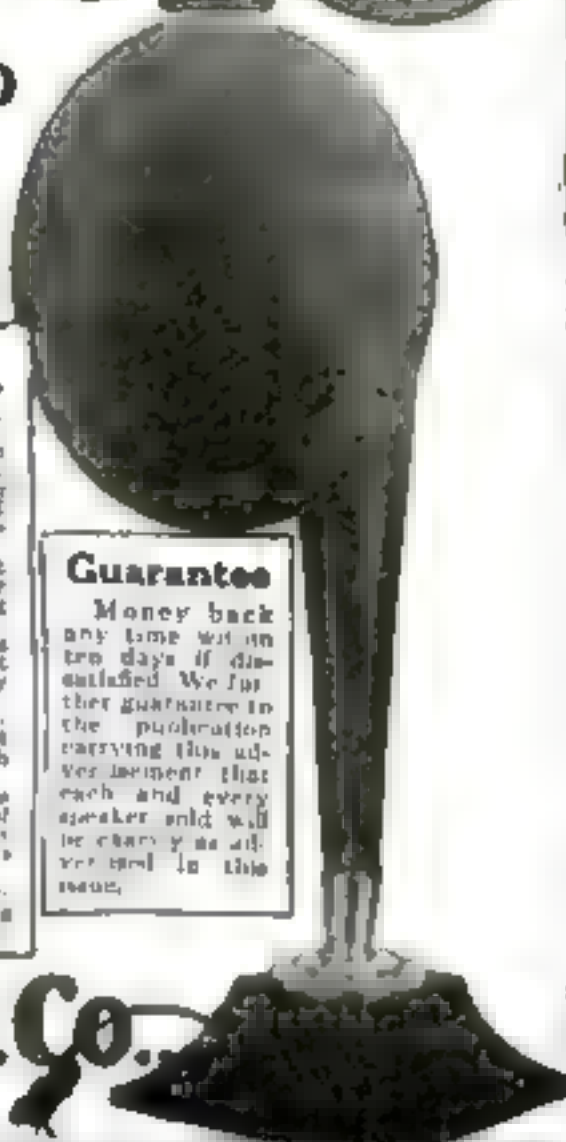
200 BENSIL-BONIS Inc., Dept. P. S.  
Second Street & Factory 417-419-421 E. 34th St., N. Y. C.  
Tel. 9942 Yonk.

### POINTS OF BEL-CANTO SUPERIORITY

1. Owns 100% patent.
2. Owns 100% patent.
3. The base of cast iron weighing four pounds, resonating top horn.
4. All other metal parts are of heavy cast aluminum, highly polished.
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6. Guaranteed for one year from date of purchase against mechanical defects of any kind.
7. No other amplifier has been sold for 400 in. or more at \$10.

### Guarantee

Money back any time within ten days if dissatisfied. We put our guarantee in the publication carrying this advertisement that each and every speaker sold will be every as advertised in this issue.



## TOOL CHESTS

For TOOLMAKERS and MECHANISTS

Finest quality best material, strong construction make them worth much more than they cost. Catalog from H. GERSTNER & SONS, 384 Columbia St., Boston 10.

## Coburn Screw-Holding Screw Driver

(Patented)

A new invention. Holds any screw by its slot. As good as a third hand. In handling anything is in a way to an automobile. Every man wants one of these wonder tools. \$1.00 Post Paid. Write for details to address. Write Dept. B.

THE COBURN TOOL COMPANY, Inc.  
114 Bedford St. Boston, Mass.

## SEND NO MONEY

2 IN SOLID GOLD  
2 Genuine Diamonds  $\frac{1}{100}$  Each

\$30.00  
Without Bank or Cash  
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Terms if Desired  
14-Kt. White Gold  
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### Hope Ruby

Can also be had  
in Black Onyx.



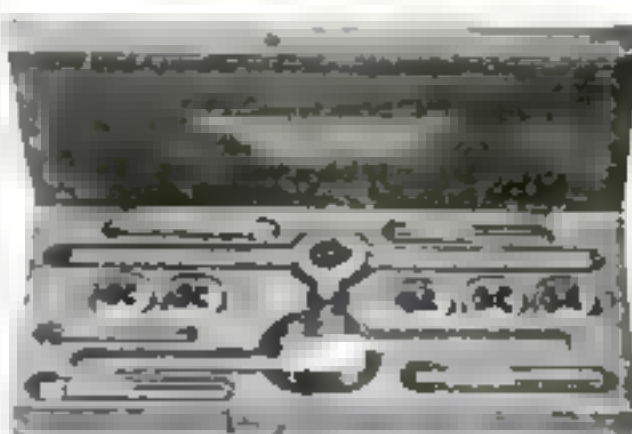
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This Reg. Trade Mark  
guarantees you genuine diamonds.  
Also in Eagle-Head-32° (Double Eagle)

Send initial and finger size and ring will be sent  
for inspection. Monthly payments if desired.

BUFFALO JEWELRY MFG. CO., "The Red Order House"

Dept. A Bickham Building Buffalo, N. Y.



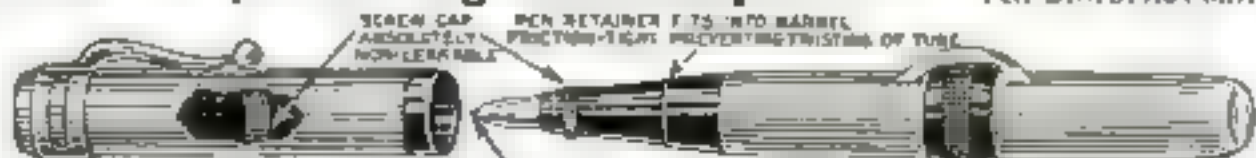
### Special 5 Size Tap and Die Set, Only \$3.00

DIRECT FROM THE FACTORY TO YOU  
Our No. 10 Standard Tap and Die Set is our highly finished standard  
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details. 1 set in the same as No. 10. 1 set in the same as No. 10. 1 set in the same as No. 10.  
Send in your order of now and be one of our many satisfied customers.  
Let us show you one of our circulars illustrating our full  
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WORCESTER STEEL PRODUCTS CO.  
Dept. B, 20 Union Street, Worcester, Mass., U. S. A.

## Sells for \$1.25. Agent's Sample 65c!

New Self-Filling  
Bamboo Fountain  
Pen with Style Point



ITS THE POINT HAS EIGHT GROOVES FOR INK TO FEED  
Imported from Japan. It makes Carbon Copies. Guaranteed for 1 year. F. SPORS & CO. 199 5 4th St. Levee Center, Minneapolis



# "How I Became Popular Overnight!"

"They used to avoid me when I asked for a dance. Some said they were tired, others had previous engagements. I didn't 'wake up' until a partner left me standing alone in the middle of the floor."

"That night I went home feeling pretty blue. As a social success I was a failure. I wouldn't believe dancing could be taught by mail but I figured I could risk 25c.—since you guaranteed to teach me."

"Since becoming a good dancer I am invited everywhere. No more dull evenings. My whole life is happier. And I owe it all to Arthur Murray!"

"I was astonished to see how quickly one learns all of the latest steps through your diagrams and simple instructions. I mastered your course in a few evenings and gave the folks around here a big surprise when I got on the floor and went through the dance letter perfect. I can lead and follow perfectly and can master any new dance after I have seen a few of the steps."

More than 120,000 people have learned to dance by mail and you can learn as easily. Arthur Murray is world's foremost authority on social dancing. Through his new method you get the same high class instruction in your own home as if you took private lessons in his studio.

## Five Dancing Lessons Free

So sure is Arthur Murray that you will be delighted with his amazingly simple instruction, or a limited time only he will send FIVE FREE LESSONS to all who write for him.

These five lessons are purely to prove that you can learn to dance without music or partner in your own home.



Found by  
Hope Hampton  
and Arthur  
Murray

Just send 25c. (stamps or coin) to pay postage, printing, etc., and the lessons will be promptly mailed to you. Don't brook. You place yourself under no obligation. Write today. Arthur Murray, Studio 124, 284 Madison Ave., New York.

## Strawberries and Other Plants Grown in a Barrel

EVEN if you live in a congested city, with little or no gardening space, it is not necessary to forego all the pleasures of gardening. You can resort to barrel gardening, just as an ingenious resident of San Antonio, Texas, has done.

All that is needed is a wooden barrel perforated with holes. Plant in the holes whatever your fancy dictates. In the

case of the San Antonian, this happened to be strawberries and quite enough strawberries are grown to satisfy the palate of a small household. With such a forcing barrel, strawberries can be started and grown to maturity much sooner in the spring than they can be in the open garden.



The barrel garden with strawberry plants

den. After the strawberry crop is over, the plants may be removed and other plants substituted, thus keeping the barrel garden going all summer.

Be sure to provide a rich, loamy soil for your barrel, and then be sure that you have an iron pipe running down into the earth. Holes must be drilled in the part of the pipe that is to be buried, so that water poured into it will reach all levels of the soil. Then, if the bottom of the barrel is drilled with small holes, the surplus water will drain out instead of standing and souring the soil.

Quite a variety of small vegetables and flowering plants may be grown in such a barrel, including pansies, petunias, phlox, verbenas, lettuce, onions, and various greens.—A. W. ROSE, San Antonio, Tex.

## Time-Saving Jack for Doors

FOR holding doors while planing the edges and putting on hinges, the jack illustrated is a time-saver. The base should be long enough to take the highest door to be hung, and the height of the



This fixture holds firmly for planing the long edges and fitting the hinges

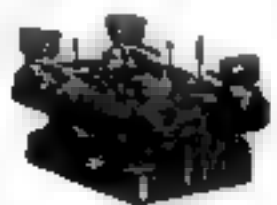
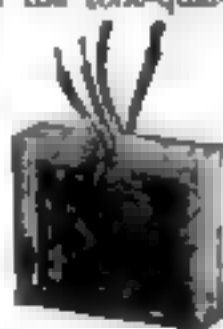
vertical part of the jack must be less than the narrowest door, usually about 2 ft. The end of the door is pushed in the notch of the slanting brace and the lower edge rested against the side stop on the base. The floor supports should be 20 or 24 in. long. The base and slanting brace are 2 by 4 in. pieces; all other material is 3/4-in. stuff.—F. M. ARTHUR, Bethune, S. C.

## A New Transformer—Built for Music



The correct design of the Kellogg transformer is a result of exhaustive study of sound waves and of the audio-frequency currents representing them, and has eliminated to the last degree of distortion of overtones which gives the tone-quality to the wave being amplified.

Our 25 years of experience building transformers has developed a one piece silicon steel, laminated core, note the absence of punched holes, which so frequently cause loss of power. Not less carefully made is the brass shield, which makes close mounting possible without interference.



Note also how the ends of the windings are brought out and soldered in plain sight to the terminal posts; there are no concealed soldered joints.

Terminals plainly marked for connecting.

If your dealer or jobber does not handle Kellogg equipment, write us mentioning his name.

No. 501 . . Ratio 4:1 to 1 . . \$1.50  
No. 502 . . Ratio 2 to 1 . . . 4.50



Use—Is the Test

**KELLOGG SWITCHBOARD & SUPPLY COMPANY**  
1066 W. ADAMS STREET  
CHICAGO, ILL.



## Increase the range of your one tube set with the Duraltran

Don't discard your one-tube regenerative set because you can't get the distant stations. The Duraltran, the wonderful Dubilier radio-frequency transformer, will bring them in. And you will save the ten or fifteen dollars you would spend in buying new parts for a radio-frequency set.

The Dubilier Duraltran does this because it amplifies more than twenty times on all broadcasting wave lengths.

## Free Blue Prints Show How

Your dealer sells Dubilier Duraltran. Price \$5.00.

Write for free Dubilier blue prints of hook-ups. They show how a Dubilier Duraltran will convert your one-tube set into a sensitive radio-frequency receiver.

## Dubilier Condenser and Radio Corporation

40-42 West Fourth Street New York



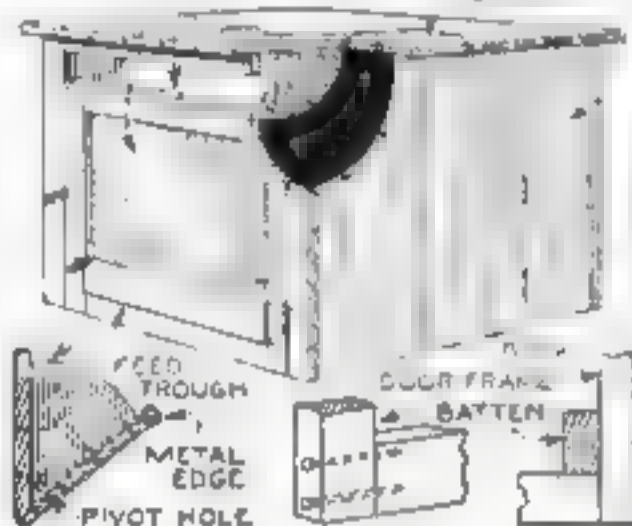
## This Unique Rabbit Hutch Has Hay-Rack and Feed Trough

ALTHOUGH most boys at some time or other keep rabbits, few of them know how to build first-class hutches for their pets. It takes a little longer to build a good hutch like the one illustrated than to use an old box or barrel, but the result is worth while.

The first feature is that all feeding of the rabbits is done quickly without opening the doors, and the second is that the hutches are made on the unit plan, which allows new sections to be added as the stock increases in numbers.

Ordinary 1 by 2 in. roofing bats are used for the front, although any available wood will do. Tongue-and-groove ceiling,  $\frac{1}{4}$  in. thick, forms the ends and back, and

POULTRY NETTING TONGUE AND GROOVE



Food is placed in feed trough or hay-rack without opening the door

common tongue-and-groove roofers serve for the top. A good size for a unit hutch is 2 ft. 2 in. wide, 2 ft. 3 in. high, and 16 in. deep.

Cover the top with duck, preferably 10 oz., painted on both sides, or with prepared roll-roofing. The next two units that are added require no top, as they are placed below the first one and merely fastened to prevent slipping.

The feed trough, which is pivoted on the door frame as shown, is tilted forward and filled from the outside with oats or other food. A piece of tin or galvanized iron tacked over the inside edge of the feed-trough prevents the rabbits from gnawing away the wood. The rack above the door is for hay in the winter and grass in the summer. The rabbits pull it through the 1-in. poultry netting, a piece at a time. Since they have to stretch up for it, they obtain much needed exercise, and this keeps them in good condition; it is, indeed, one of the secrets of having large, healthy rabbits.

The wire netting over the door frame is tacked on the inside with small staples. The hay-rack is fastened above the door, and well tacked at the ends.

## Rubber-Capped Hammer

IN PLACE of a soft hammer or mallet I keep in my toolkit an ordinary crutch tip of large size. This slip over the head of an ordinary nail hammer, use and convert it into a soft hammer for driving together parts that otherwise might be damaged by hammer marks.

J. M. Gray, Lansing, Mich.

# \$100 Down

Just one dollar—the balance in easy monthly payments. Write today for FREE Book of Advance Watch Styles. Learn how, for only \$1.00 down, you can get—direct from factory—a

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Choice of 54 newest Art Beauty Cases; 8 handsome dial designs. 8 adjustments, including heat, cold, moisture and 5 positions. Insured for a lifetime. Direct from the market at lowest prices ever named on equal quality. Send for the Book!

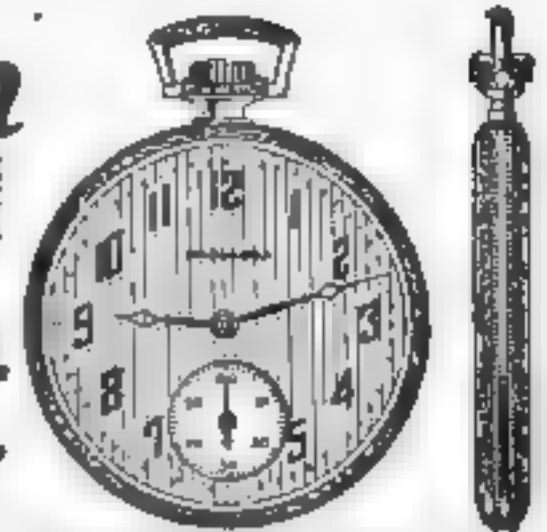
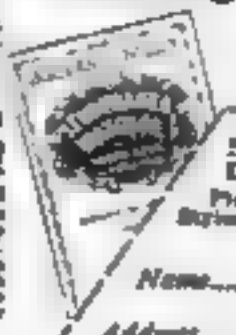
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Send today for copy of this book—FREE! See newest Advance Watch Styles. Get \$1.00 down offer. Write!

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Please send me your Free Book of Advance Watch Styles and particulars of your \$1.00 down offer.

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Only 10,000 of these marvelous, instantaneous picture-taking and making cameras to be sent out absolutely on approval without a penny in advance just to prove that it is the most wonderful invention—the camera operation of the age. So you must send for it quickly! Just think of it—the new Model-ette!



### TAKES AND MAKES Finished Pictures Instantly

You press the button, draw card in developer and in one minute take out a perfect finished post card photo 2 1/2 x 3 1/2 inches in size. Camera, itself, is about 4 1/2 x 3 1/2 x 3 1/2 inches. Works in daylight or in 10 foot candle light.

**No Film—No Plates—No Dark Room**

Not a bit of the mess and bother of the ordinary Kodak or camera. It is instantaneous photography. Universal form lens produces sharp pictures at all distances. Pictures develop and print automatically. Can't overdevelop; results simply amazing.

### We Trust You

No difference who you are, where you live or what your age, we will send you the complete "Model-ette" camera absolutely on approval and give you 10 days to test it. If not satisfactory return it. But when you see what instant pictures it takes—so quick, so easy, with no trouble at all! If you wish to keep it you simply send us \$1.00 per week with our special price of only \$20.00 in cash.

### Easy Payments—No References

No red tape of any kind. Weekly payments so small you'll not notice them. Lots of fun and big profits.

### No Experience Required

Plain instructions and everything complete with outfit so you can begin taking pictures the moment it arrives. We guarantee that even a child can operate it. Mail coupon right now. No risk or obligation to keep camera.

### The Chicago Ferris Co.,

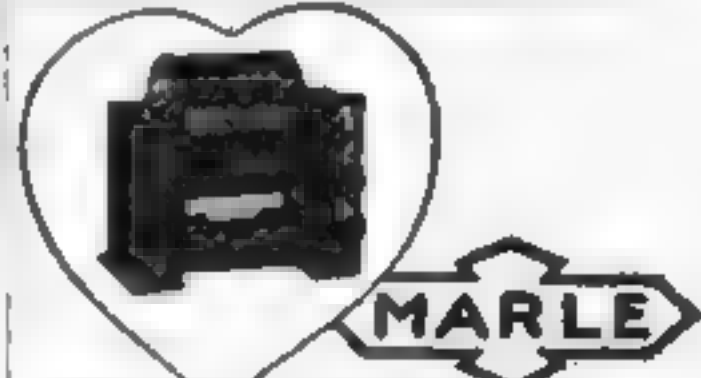
2300 W. Erie St., Dept. 11 Chicago, Ill.

Send me at once one complete Model-ette camera outfit including supply of post cards and instructions. I agree to examine and test it thoroughly and if satisfied keep it and pay you \$1.00 a week until your special price of \$20.00 is paid. Otherwise I will return it at the end of 10 days.

Name.....

St. and Ph.....

Address.....



## Radio & Audio Frequency TRANSFORMERS

### "The Heart of a Good Receiver"

**P**ERFECT amplification is the boon you secure when you buy a Marle Transformer. Radio impulses are magnified to the uttermost limit without a sign of distortion. True over the widest range of frequencies. Special folders showing the hookups for standard circuits, sent upon request.

Write for hookups and  
**Illustrated Folder TODAY!**

Your dealer sells Marle Transformers, or write to us for the names of the nearest Marle dealer.



**MARLE  
Engineering  
Company  
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Audio F  
Type A7  
Ratio of  
3 1/2 to 1



Radio F  
Types  
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and R2





## "Mary, I Owe It All to You"

MR WILLIAMS called me into his office to-day and told me he was going to raise my salary \$50 a month.

"I am glad to give you this opportunity," he said, "for the best reason in the world. You deserve it."

"You may not know it, but I've been watching your work ever since the International Correspondence Schools wrote me that you had enrolled for a course of home study. Keep it up, young man, and you'll go far. I wish we had more men like you."

"And to think, Mary, I owe it all to you." I might still be drudging along in the same old job at the same old salary if you hadn't urged me to send in that I. C. S. coupon.

How about you? Are you always going to work for a small salary? Are you going to waste your natural ability all your life? Or are you going to get ahead in a big way? It all depends on what you do with your spare time.

More than 1,000,000 men are getting ready for promotion right now in the I. C. S. way. Let us tell you what we are doing for them and what we can do for you.

Mail the Coupon To-day

INTERNATIONAL CORRESPONDENCE SCHOOLS  
Box 7455-C, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject before which I have marked an X.

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# The Shipshape Home



## Cutting Glass

IN MAKING repairs about the home, it is sometimes necessary to replace

broken pane of glass or do other work that requires the use of glass. The principal difficulty the home worker experiences in such cases is cutting the glass to size.

To do this we must have a glass cutter. Nothing else will take its place, and, since a glass cutter is needed badly when it is needed at all, it is best always to have one in the tool cabinet. There are several kinds on the market, some with a single roll, others with two or more in a sort of turret. I prefer the latter as being more economical if long usage is expected.

Mark out the size of the glass—and if it is a window pane, do not figure on making it too tight a fit in the glass rabbet—and lay a straight edge along one of the edges you intend to cut. Hold this firmly so that it cannot slip. This is best done by placing the thumb and little finger of the left hand on the glass, and the first, second, and third fingers on the straight edge. Be sure that all grease and dirt have

been wiped from the glass where the cutting is to be done. The cutter should be held between the first and second fingers of the right hand, resting well down between the fingers on the knuckles, with the fingers pressing the flattened part of the handle firmly against the thumb.

Use only enough pressure on the cutter to make a clean, even scratch. Don't go over the cut twice, as the fine dust from the glass of the first cut will dull the wheel.

If the cut has been made with even pressure, the border or waste part can be broken off easily with the fingers, starting nearest yourself and working away. If the

border is narrow, it should be nipped off by means of the breaker teeth on the cutter.

It goes without saying that the glass being cut must rest on a flat, clean place or the glass will be broken at the very start by the pressure of the cutter. Any one who will practice a short while cutting waste pieces in this way, will find it surprisingly easy.—HENRY B. LARABY, New Haven, Conn.



The cutter is drawn with firm pressure once along the straight edge

## Mounting an Ironing Board

WHEN there is a chair rail around the kitchen wall it is comparatively easy to mount an ironing board so that it will fold up flat against the wall when not in use.

Hinge a leg to the board, as shown, and fasten on the upper side of the leg near the lower end a block shaped as indicated from 1-in. lumber. Its outer edge is covered with a strip of felt, which rests against the plaster wall when the board is raised.

Diagram of ironing board in raised and lowered positions

The board itself is hinged to the plate rail and a cleat and stop block are fastened beneath the hinged end, as represented, so that the leg, in the raised position, rests in a sort of cradle or notch. An L-shaped latch of strap iron is pivoted to the cleat, so that it can be turned to hold

the leg in place when the board is up, and this automatically prevents the board from falling.

No bothersome hooks or catches are necessary to keep the board up, and no holes have to be made in the plaster wall, which is a great advantage from the viewpoint of both convenience and appearance.—WALLER C. HORNADAY.

## Coal Windows

IN WINDOWS where there is a chance of breakage such as the small panes of glass in a coal window, the use of wooden strips in place of putty is often advisable. Beading sawed from old matched boards will serve the purpose, if trued up a little with a plane. The strips should be as long as the inside measurements of the sash and mitered at the ends. They may

SCREWS 1/2" LONG  
Strips replace putty



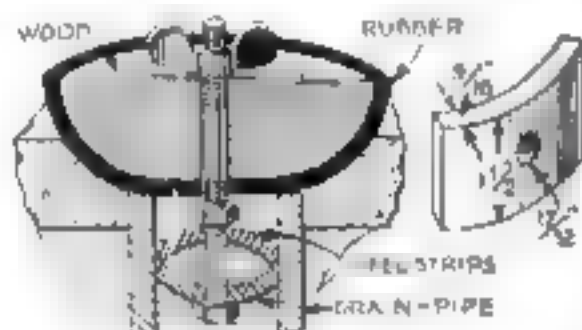
## The Shipshape Home

(Continued from page 126)

or may not be beveled, as preferred. Fasten them in place with  $\frac{3}{4}$ -in. long flat-head screws, either brass or iron, rather than with brads or small nails. If properly made and fitted, the strips should shrink very little. They will be found to save much time when the glass needs resetting.—R. C. T.

### Preventing Back Flow

ANYONE who is troubled with water backing up in the basement after a hard rain, will find useful a drainpipe cap made as shown. All that is needed are two cold rolled steel strips  $\frac{3}{16}$  in. thick,  $1\frac{1}{2}$  in. wide, and long enough so that they will fit snugly into the drainpipe after they have been bent until the distance



Expanding clamp allows rubber-covered wooden block to be screwed tightly over drain

between them at the center, when inserted as indicated, will be about 1 in. By placing the strip face to face on a  $\frac{1}{4}$ -in. stud, inserting them in the drainpipe and screwing down on the upper nut, the fixture will be wedged firmly in place. The cap, which is simply a shaped wooden block faced with rubber, can then be tightened over the pipe by a wingnut.—J. M., Waukegan, Ill

### Spots on Wallpaper

IF AN extra piece of wallpaper has been saved from the paper hanger's scraps, it is not difficult to cover up a bad spot on the wall. Cut out a piece of the spare wallpaper slightly larger than the spot and quite irregular in shape. Then, with a safety razor blade or a sharp pen-knife, shave away the back of the paper to form tapering edges. Paste on the patch and roll it smooth.—A. M. Smyth, Germantown, Pa.

### Finishing Chair Seats

VENEERED wooden seats sold to replace broken chair seats may be finished to match the color of the chairs on which they are placed or in colors more suitable than the clear varnish. The finished side of the new seat is past staining a few color unless the varnish is removed, but the seat may be turned over and what was intended to be the underside may be made the upper. Trim the seat to the proper shape and size and bevel the edges so that they will not be uncomfortable. Then, when the raw wood surface any shade desired, fill with either white or orange shellac, sandpaper, give coats of varnish or wax, if desired, and tack carefully in place with upholsterers' tacks.—GEORGE E. BLACK, Greencastle, Ind.

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# A "Vintage Smoke"

The Major tells Joe Rivers what "tasty-smellfulness" really is

Some time ago Mr. Joe Rivers, a confirmed smoker of Edgeworth, defined the friend-making, friend-holding quality of Edgeworth as "tasty-smellfulness."

In the following letter Major Edmund simplifies this description into one word, "bouquet"—which Webster defines as "an aroma as of wine."

As a matter of fact most of us taste tobacco with our noses to a large extent.

Dear Joe:  
Your letter about Edgeworth in the "Saturday Evening Post" for 24th November demands an answer but I am afraid this effort of mine will not reach you in time to be of much use. Some quick-witted Yankee from New York, Maine, will be sure to barge in between us. You have hit on something very appealing to the Englishman.



What you are talking about in your letter is bouquet, and Edgeworth is the only tobacco possessing it, so far as I know. I tried them all, until William Forbes of Boston met me in Lurgan one day two years ago and heard me cursing the impud Swiss air blue because I had a sore tongue. He told me about Edgeworth and I

went to the Post Office and wired London to send me out a sample. Since then—but you know the rest!

Edgeworth doesn't need any fine writing to explain it. The "bouquet" you mention varies for it depends on what you have been eating, what you have been drinking, what the temperature of your room is, whether your pipe has been preceded by a cigar whether you have sold out your oil shares at a profit, and how you feel generally.

If you write to Larus again make him pay you a royalty for your discovery (unless he saw it first) and tell him what this elusive beauty really is that has made him famous in two worlds.

Yours faithfully, Joe  
JAMES EDMUND.

We try to put into the blue tin a tobacco that has the quality of friendliness.

This quality may mean "comfort" to one man, "flavor" to another, "tasty-smellfulness" to Mr. Rivers, and "bouquet" to Major Edmund. There may, indeed, be some doubt as to just what it is, but there can be no doubt whatever that a great many men recognize its presence.

You may not find Edgeworth to your taste, and then again you may. It may prove to be just the right smoke for you as it has for so many others.

At any rate we'll be glad to have you try it at our expense. Just write your name and address on a postcard and mail it to Larus & Brother Company, 59 South 21st Street, Richmond, Va., and you will receive, postpaid, generous samples of both Edgeworth Plug Slice and Ready-Rubbed. If you care to write the name and address of your regular tobacco merchant the courtesy will be much appreciated.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

## Stone Bird Bath Is Artistic Garden Ornament

By Herbert C. Crocker

TO BUILD the artistic bird bath shown requires only a sack of cement, a bushel of sand, a little effort to gather some odd shaped field stones, and enough manual labor to put them together properly. The places between the stones are filled with dirt, in which ferns are planted. Hundreds of birds visit the fountain during warm weather to get a drink or bath. After the feed and waste pipes are set, a circle is inscribed around the first to



Built over an earthen mound, this attractive fountain requires little cement and stone

indicate the outside dimension. A mound of dirt may then be built in the center to save all but the outer course of stone. This dirt also assists in holding moisture for the roots of the ferns. A portion of the dirt near the center of the mound is removed to allow the construction of the basin, which is made of cement and sand about 2 in. thick, and from 4 to 6 in. deep in the center.

The waste pipe is set to maintain a depth of 3 or 4 in. of water. An old garden hose nozzle may be used to provide the spray. The overflow pipe may empty into a sewer, a cesspool or stone hole, or any convenient type of drainage may be provided.

## Pen for Drawing Heavy Letters Whittled from Wooden Stick

FROM a professional sign painter I learned the little trick illustrated of cutting a heavy lettering pen from a stick of soft wood. It can be whittled quickly with a penknife and the width can be regulated with a rasp to any size desired. When properly made the pen draws clear-cut lines of a uniform width.

In laying out large block letters, this sign painter used a method that may be new to some readers. He broke a piece of round blackboard chalk off the same length as the width of the letter stems, and then, holding the piece sideways, drew the letters in place with single strokes. This gave him at once the exact width of line required. When the lettering was properly spaced, he outlined the letters in pencil.—H. T.



SOFT WOOD

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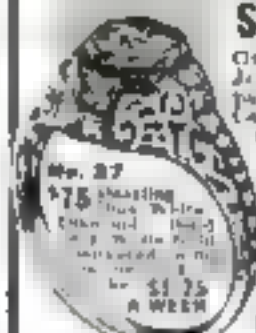
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## Modern Dining Alcoves

(Continued from page 81.)

for both benches. The stretchers and back rail are doweled; the other rails are screwed to the legs. The screws are covered with small caps  $\frac{1}{8}$  by  $\frac{1}{8}$  by  $2\frac{1}{4}$  in., which are glued and braded in place to give the appearance of tenons projecting through.

The seat back is merely a frame with ornamental panels. The top and bottom stiles are  $1\frac{1}{4}$  by 4 in. by 4 ft. 4 in. and are plowed to take the panels. The rails are  $1\frac{1}{4}$  by  $3\frac{1}{4}$  by  $17\frac{1}{4}$  in. The panels are  $\frac{1}{2}$  by  $3\frac{1}{4}$  by  $17\frac{1}{4}$  in., 14 being required. They are intended to be fastened together and cut all at once on a bandsaw, which is a very simple operation, but the home worker can prepare them with hand tools, if he wishes, or supply the design in any way he pleases. In fact, plain panels would look very well and are often used in good work of this kind.

Beneath the feet are placed small shoes,  $1\frac{1}{4}$  by  $2\frac{1}{4}$  by 3 in. Twenty-four dowels



Fig. 4. A breakfast nook often gives additional service as a children's play corner.

$\frac{3}{4}$  in. in diameter and  $2\frac{1}{4}$  in. long, as well as screws and glue, will be required.

The table top is  $1\frac{1}{4}$  by 2 ft. 6 in. by 4 ft. 6 in., and the table stands the usual 30 in. from the floor. The legs are  $1\frac{1}{4}$  by  $1\frac{1}{4}$  by  $26\frac{1}{4}$  in. The base feet are  $1\frac{1}{4}$  by  $2\frac{1}{4}$  by  $20\frac{1}{4}$  in.

The top cleats are  $1\frac{1}{4}$  by  $2\frac{1}{4}$  by 28 in. and the legs are notched to suit them, as indicated in Fig. 2. Each pair of legs is connected by two end rails  $\frac{1}{4}$  by  $2\frac{1}{4}$  by 12 in. Between each is placed a panel to match the seat panels,  $\frac{1}{4}$  by 4 by  $9\frac{1}{4}$  in. Between the upper end rails runs the table shelf,  $\frac{1}{4}$  by 11 in. by 8 ft. 1 in. Two stretchers  $\frac{1}{4}$  by  $2\frac{1}{4}$  by 8 ft.  $\frac{3}{4}$  in. join the feet and brace the whole construction. Four feet shoes,  $\frac{1}{4}$  by  $2\frac{1}{4}$  by 3 in., 36  $\frac{3}{4}$ -in. dowels  $2\frac{1}{4}$  in. long, screws, and glue are required also.

In constructing the design shown in Figs. 3 and 4, fewer parts and less joinery are called for. Once the ends of the bench and table are prepared, the work is relatively simple. It is advisable to have these large pieces cut on a bandsaw at a mill or carpenter shop, but they can be prepared at the cost of a little time and effort with a compass saw and ordinary hand tools.

(Continued on page 130)

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## Modern Dining Alcoves

(Continued from page 129)

The ends of the benches are  $1\frac{1}{2}$  by  $18\frac{1}{2}$  in. by 3 ft. 8 in. If stock wide enough cannot be obtained, they will have to be glued up. By laying out one within the other on the board, they can be cut without much waste of material. The ornamental openings are made with an expansive bit in a hand brace, but if such a bit is not part of the builder's tool equipment, openings of other shapes may be sawn out after holes are first bored for the point of the compass saw to enter.

The seats are  $1\frac{1}{2}$  by 11 in. by 4 ft. 8 in. Underneath the front edge of each seat runs an apron  $\frac{1}{2}$  by 1 in. by 4 ft. 3 in. A brace 1 by 4 in. by 4 ft. 3 in. holds the ends together at the bottom. The back is simply a large frame with a single panel of 6-ply veneered stock. The top stiles are  $1\frac{1}{2}$  by 4 in. by 4 ft. 5 in. and the bottom stiles  $1\frac{1}{2}$  by 5 in. by 4 ft. 5 in. The end rails are  $1\frac{1}{2}$  by 4 in. by 19 in. (really 18 in. between the shoulders, as the joint between the rails and stiles is a tongue-and-groove joint, doweled). The panels (one for each bench) are  $\frac{3}{4}$  in. by 18 in. by 3 ft. 10 in. The seats are carried on cleats  $1\frac{1}{2}$  by  $1\frac{1}{2}$  by 15 in. Twelve glue blocks  $\frac{3}{4}$  by  $\frac{3}{4}$  by 2 in., 24  $\frac{3}{4}$ -in. dowels 2 in. long, screws, and glue also will be needed.

## Make All Measurements with Care

The table top is  $1\frac{1}{2}$  by 30 in. by 4 ft. 6 in.; the table ends are  $1\frac{1}{2}$  by 18 by  $29\frac{1}{2}$  in., and the shelf is  $\frac{1}{4}$  by 11 by  $86\frac{1}{2}$  in. The cleats for the table top are  $1\frac{1}{2}$  by 2 by 28 in. The stretcher at the bottom is  $\frac{1}{4}$  by 4 by  $36\frac{1}{2}$  in. Twelve dowels, screws, and glue also are needed.

Properly made, either one of these dining alcoves will be well worth the most careful finishing. Sandpaper all the surfaces perfectly smooth and then apply enamel undercoating and enamel, or stain and varnish to match the trim of the room.

Working drawings for both designs, as well as complete bills of materials and full-size views of the important joints are contained in Home Workshop Blueprint, No. 33, which will be sent to any reader for the nominal charge of 25 cents to cover the cost of blueprinting, handling, and mailing. Address Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York.

## Making a Cesspool

TO MAKE a tight-fitting and strong cover for either a new cesspool or an old one being repaired, is a simple matter if an old dishpan is used as a form. Build up the sides until they surround the pan closely, as illustrated, and fill in around the pan with cement. Also fill the pan itself and bury a handle in the moist concrete. When the cement is hard, remove the pan. The concrete slab then will plug the opening and make a perfect joint.—O. M. A.



A dishpan is used as a form.

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## Emotions—The Fuel of Life

(Continued from page 38)

men always to be clean, neatly dressed, punctual, and respectful to their employers were founded not alone on common sense, but on sound psychology, for the emotions of others are moved by the impressions that we make through our appearance, voice, and demeanor.

The most important of these, I should say, is demeanor. The man who is bad tempered and who shows it on trivial occasions, creates a bad impression—an impression that may influence his success and happiness throughout life.

The difference between the successful man and the unsuccessful man is that the former does not betray his terror, his weariness or his defeat, but continues to fight, no matter what the odds against him. He achieves success by controlling his emotions. In doing so he stirs the emotions of others, who cannot but admire and respect his steadfastness and courage.

There is an interesting term—"psychic contagion"—that expresses the extraordinary power of strong emotion to pass from one person to another quite as quickly as an epidemic. "The psychology of the crowd" is another way of saying the same thing.

A year or so ago at a baseball game in an Eastern city, I saw a typical American crowd suddenly become an unruly mob when an umpire made a decision unfavorable to the home team at an important stage of the game. Bottles and other missiles began to rain on the field, and the roars of the angry spectators were terrifying.

### What "Psychic Contagion" Will Do

And yet the vast majority of the individuals composing that crowd were decent and respectable members of society, law-abiding and orderly under normal conditions. Apart from a crowd, few of them probably ever would be angered to the point of attempting to assault another with a dangerous weapon. Yet so strong is the force of example, so fierce the power of emotion when aroused, that the most peaceful man in those stands probably approved the action of the ruffians who led the assault on the umpires and players.

Under the stress of such emotion lynchings and similar violent outbreaks take place. Many of the men who make up a mob undoubtedly would condemn in cold blood the activities in which they take part while under the sway of emotional excitement. The fatal panics that often accompany shipwrecks, fires, floods and similar disasters are due to the same sort of psychic contagion.

On the other hand, serious panics and scenes of violence have been averted because some one has possessed the coolness and courage to instill in a crowd some emotion other than the terror or rage which is actuating it. A most significant instance of this sort occurred during the war. A column of French soldiers was marching through a little town in the center of which was a large open square. German gunners ten miles away had the

(Continued on page 132)

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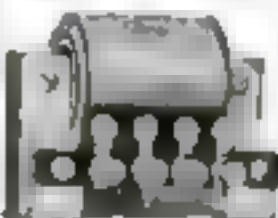
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## Emotions—The Fuel of Life

(Continued from page 131)

range of the square, and were dropping shells into it at irregular intervals. The soldiers, of course, discovered this fact. Despite discipline, they feared to cross the square and sought to pass round the edges, thus creating confusion.

A French general of very ample proportions ordered a large armchair to be placed in the middle of the square and, with a light cane in his hand, settled himself comfortably in the chair and joked with the soldiers as they marched by. Though the bursting of shells in the square continued, not a soldier flinched after the general had taken his station. Though inwardly they may have felt timorous, none would exhibit signs of fear.

For, though cowardice and rage are contagious, so is courage. In fact, the better emotions seem to be transmitted more readily than evil emotions. We learned during the war that it does not need the rigid discipline of military life to produce morale.

### Learn to Control Emotion

Such control and direction of emotions not only is possible but entirely useful. Much has been said in recent years of the evil effects of repression of the feelings and emotions. All this, though, comes from a school of treatment of nervous diseases that has no meaning for ordinary, normal individuals. Persons whose minds are disturbed and who by heredity have tendencies to nervous manifestations sometimes may disturb their mental equilibrium by their exaggerated efforts to repress some of their tendencies. The great majority of mankind, however, is benefitted by habits of repression.

Nurses, physicians, clergymen and others who attend the sick always have controlled their emotions. In fact, most sensible persons whose work has brought them into intimate contact with their fellow men have learned repression.

Psychology is intensely practical. Its principles may be applied to the benefit of every one in the ordinary activities.

As with our senses in the acquisition of knowledge, so with our emotions they cut rapidly into the grooves of habit according to the use we make of them. Cultivation of our better emotions and repression of our less worthy ones—ruling our emotions rather than permitting them to rule us—these are the methods by which character is formed.

There is no illusion in that expression, "the formation of character." For a man can make himself ever so much better than he would naturally be, and in the same way can let himself become ever so much worse than he might be. It is all a question of guarding the emotions and seeing that they work for our benefit.

How long are your legs? Did you know that the length of your limbs in proportion to the length of your body may, to an extent, be a measurement of your intelligence and your success in life? In next month's issue Henry E. Garrett, Ph.D., of the Department of Psychology, Columbia University, will tell how you can apply these measurements.

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## Science Sees, Hears, Counts Atoms

(Continued from page 45)

incandescent lamps that light your home, the arc lights on the street corners—these all perform their functions because electric current is flowing through them. And electric current, it has been shown, is simply the passage of electrons from one tiny atom to the next.

If you will imagine a piece of copper wire as made up of a line of atoms, you can visualize how this operation takes place. Take a single electron from the last atom of the wire and add it to the first atom. You probably can picture the process best if you think of it as resembling one of the basketball relay games that children play. As soon as you've transferred that electron, the atom at the end of the line immediately busy themselves trying to get it back to place. The first atom hurries it back to the second, the second to the third and so on, each little atom seemingly intent upon keeping only its normal quota of electrons and no more.

That is the way electric current flows. In some substances—copper, for example—the electrons seem to be less strongly attracted to their nuclei than in other substances. The atoms of copper pass electrons from one to the next very readily. And so copper is called a good conductor. In other substances, such as rubber and glass, the electrons are bound very tightly to their nuclei, and cannot be passed from atom to atom. These substances are known as non-conductors or insulators.

### The Most Enormous Force Known

The energy of atoms is the most enormous force that science ever has discovered. Since atoms are so infinitely small, this may seem incredible. Consider, though, the difference in destructive potentiality between a five-ton motor-truck, merely rolling along at a mile an hour, and a shell weighing less than 100 pounds but traveling at a speed, say, of a thousand feet a second. If both the truck and the projectile were to strike a brick wall, you would not hesitate to predict far different results.

That, then, is the secret of the tremendous energy of the atom—its enormous velocity. That, too, is what has permitted scientists to study atoms and to photograph atoms. Sir Ernest Rutherford was the first to discover that the phenomenon called radioactivity was due to the fact that radioactive substances were throwing off free atoms. In the case of radium, he demonstrated that the emanations consisted of atoms of helium. That is to say, radium is constantly altering its substance. It is an alchemy, a transmutation performed by the master chemist, Nature, that in time will result in the transmutation of radium into lead.

Rutherford discovered further that the splash of light from an atom cast off by a radioactive substance was visible against a fluorescent screen, and that its path in the air was outlined by condensation of the water drops it left in its wake. These phenomena permitted the movements of

(Continued on page 134)

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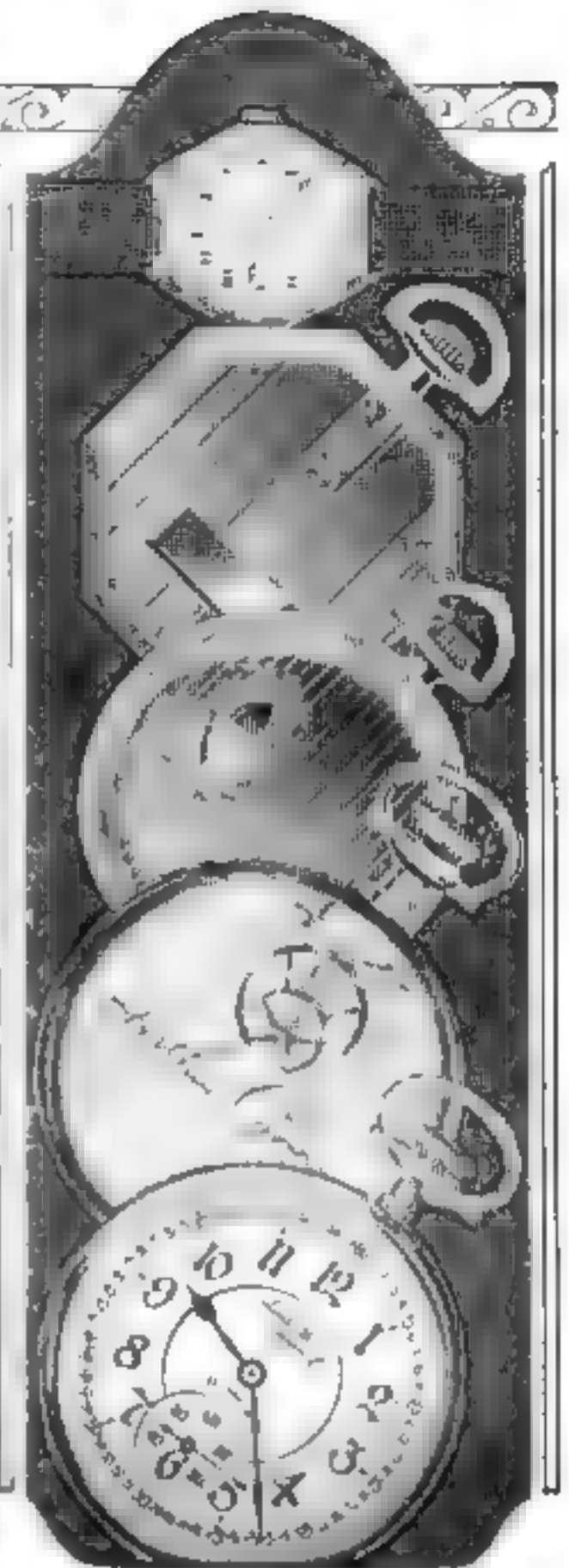
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## Adventures in Home Ownership

(Continued from page 72)

"What have bed springs to do with a comfortable night's sleep?" I laughed. "If the springs give way, you go down with them, don't you? And if foundations settle, the walls and floors settle with them; and when the walls settle, the plaster cracks. In this house, too, the cracking has been aggravated by inadequate underpinning. See the sag in that floor beam just at the base of a partition? That means more cracks."

And so I pointed out other glaring defects—the lack of sufficient supporting posts, slovenly nailing and glazing workmanship.

We trudged up the stairs for a rather forlorn visit to the second floor. Here were three delightful bedrooms, each with a spacious closet, and a tiled bath equipped with excellent porcelain plumbing. All opened into a small, but adequate hall. Yet at first glance we saw that the cheerfulness of each room was marred by ugly stains on the plaster, usually near a window. They were stains from leaking water by reason of faulty construction of the roof, plaster walls or window frames. On a door we found wood not close because the frame of the house had sagged.

By this time I saw that Marion's first bright hopes had gone glimmering.

"It's a shame," Jim muttered.

"I agree," I echoed. "Here is an unusually attractive house, equipped with every modern comfort, all ruined by poor workmanship."

## We Visit an Old House

"What about buying an old house—one that people have lived in long enough to know that it is well built—and fixing it up?" asked Marion when we were seated again in the car.

"That all depends," I replied. "I have seen the most wonderful homes created by remodeling an old house. It's a fact that some houses built before the war are better built than is the rule today. Sometimes they can be bought for less than it would cost to duplicate them now."

"Here's an old house on the list," volunteered Marion. "Let's look at it."

Arriving at the listed address, we found a deserted residence that evidently once had been the pride of a fastidious owner. It was set far back from the street, high upon an immense lot that held half a dozen beautiful shade trees. What once had been a well-groomed lawn, bordered by a handsome stone wall, now was a tangled mass of long grass and weeds.

A closer inspection revealed that first of all, the house would need a new coat of paint. The cedar shingles of the roof were curled and broken. That would mean a new roof. The floor and pillars of the porch were rotted away in places. That might mean a new porch, or at least extensive repairs. Inside, the wall-paper was faded and torn, the woodwork was marred and dingy, and in places the plaster was broken. That would mean new decoration throughout, and some re-

(Continued on page 136)



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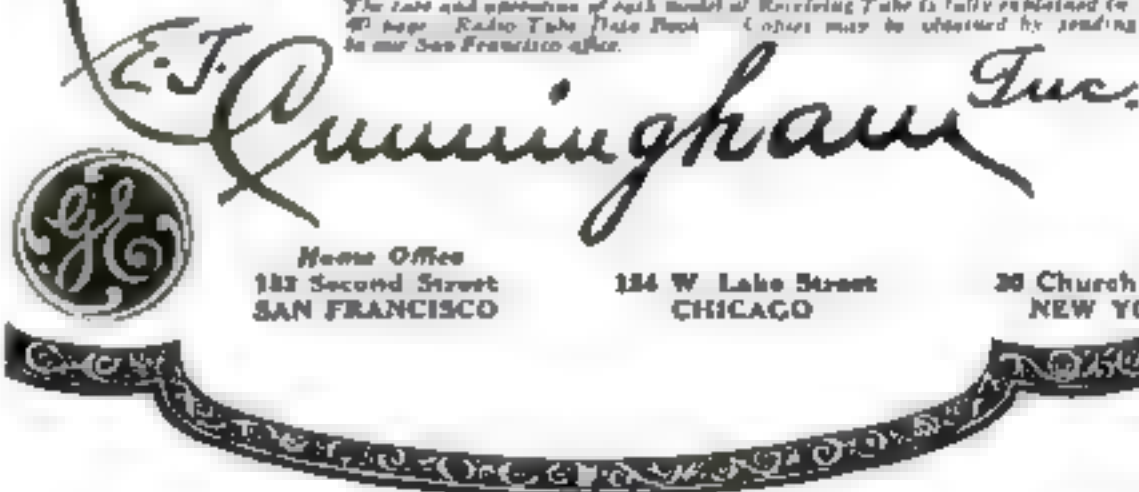
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## Loudspeaking Three-Tube Radio Receiver

(Continued from page 75)

double cotton-covered wire can be used. The number of turns on each winding should not vary more than five turns more or less than the number specified.

Number 8 is a combination grid condenser and leak. The grid condenser should have a capacity of .00025 mfd. and the grid leak, a resistance of 1 to 2 megohms. Separate grid condenser and leak connected in parallel will do as well as a combination grid condenser and leak.

Numbers 9, 16, and 20 are vacuum-tube sockets. In this case sockets for storage-battery tubes were used, but by battery tubes and sockets also can be used to advantage. In wiring them together, follow the wiring directions for connecting the various terminals, regardless of the different arrangements of the terminals. The F terminals of the sockets should be marked F<sub>1</sub> and F<sub>2</sub> to avoid confusion.

Numbers 11, 18, and 24 are single-circuit jacks. Number 12 is a carbon pile type rheostat, of six ohms resistance. Numbers 17 and 21 are ordinary wire-wound 6-ohm rheostats.

### Ratios of Transformer Windings

Numbers 13 and 22 are standard audio-frequency transformers. Transformers having a ratio not higher than five to one should be used for best results, although if desired, a higher ratio transformer can be used for the first stage (No. 13).

Number 14 is the negative B battery terminal; No. 15 the positive 22½-volt B battery terminal. If a hard or high vacuum tube is used as the detector, better results usually will be obtained if this terminal is connected with a higher voltage ranging up to about 45 volts.

Number 19 is the C battery. If a standard 4½-volt C battery is used, it can be placed inside the cabinet in a slot cut into the baseboard as shown. The terminal of the battery marked A is the positive pole; B is the negative three-volt terminal, and C is the negative 4½-volt terminal.

Number 23 is the terminal connected with the plate circuit of the second tube or first stage amplifier. The lead from this terminal to the B battery should be tried on various terminals ranging from 45 to 90 volts and left connected with the terminal that gives best results.

Number 25 is the terminal connected with the plate circuit of the last tube. The lead from this terminal can be connected with B battery voltages ranging from 90 to 112½ volts, or more, depending on the tube and loudspeaker used in the last stage. If a power tube and a rugged loudspeaker are used, voltages as high as 300 volts can be applied to the last stage.

Number 26 is the positive A battery terminal and No. 27 is the negative A battery terminal.

Bus bar wiring will give a neat and workmanlike appearance to the set.

No difficulty will be experienced in wiring the receiver if the following directions given below are observed.

First mount all the parts, with the exception of the two variable condensers, on (Continued on page 139)









## "The Loveliest Thing I've Ever Heard Over the Radio"—Mary Garden



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Electrical Research Laboratories  
Dept. F 2515 Michigan Ave., Chicago

# ERLA

## Loudspeaking Three-Tube Radio Receiver

(Continued from page 116)

20. A wire from the F terminal of transformer 13 and another wire from the F terminal of transformer 22 are connected temporarily with terminal C (minus 4½-volt tap) of C battery 19. Later when the set is in operation these wires can be tried on either of the negative terminals of the C battery and connected with the terminal that gives best results.

The P terminal of socket 16, the P terminal of transformer 22 and one terminal of jack 18 then should be connected. The spring of the jack with which this connection is made should correspond to the one used for a similar connection in jack 11. The other jack terminal, terminal B of transformer 22, and terminal 28 then should be connected.

Now connect the P terminal of socket 20 with one terminal of jack 24. The other terminal of jack 24 is connected with terminal 25. This last connection completes the internal wiring of the set.

### Battery Connections

To operate the receiver, the positive of the A battery is connected with binding-post 26, and the negative of the A battery is connected with binding-post 27. The negative of the B battery is connected with terminal 14. If a soft tube is used, the 22½-volt terminal of the B battery is connected with terminal 15; but if a hard tube is used as a detector, the lead from terminal 15 should be tried on various values of B battery, ranging from 22½ to 45 volts. Terminal 29 is connected with a B battery terminal of from 45 to 90 volts, while terminal 25 is connected with a B battery voltage of from 90 to 300 volts, depending on the tube and loudspeaker.

If a 180-degree coupler is used, it may be found necessary to reverse the connections to the rotor winding leads. This is due to the fact that regenerative action cannot be obtained if the polarity of the tickler coil with respect to that of the secondary coil is not correct.

A good way to begin feeling for a station is to try the switch arm of switch 4 on the top switch point, and then vary the adjustments of switches 6 and 7. For every combination of switch settings try varying the adjustment of the condensers and the tickler coil throughout their ranges. By recording adjustments or combinations that give best results you soon will be able to tune in any desired station with ease.

To obtain best results all parts should be tested carefully before mounting and should be distributed on the panel and baseboard as shown in the photograph. The terminals of the various instruments should be so arranged that the wiring between parts will be as short and direct as possible. In wiring, try to route the wires so that no two wires are close to each other or run parallel for any considerable distance. The only exception to this rule is in the case of the filament leads from the A battery.

Next month Mr. Calcaterra will describe how to build the various types of tuning elements.

## "I have averaged \$7000

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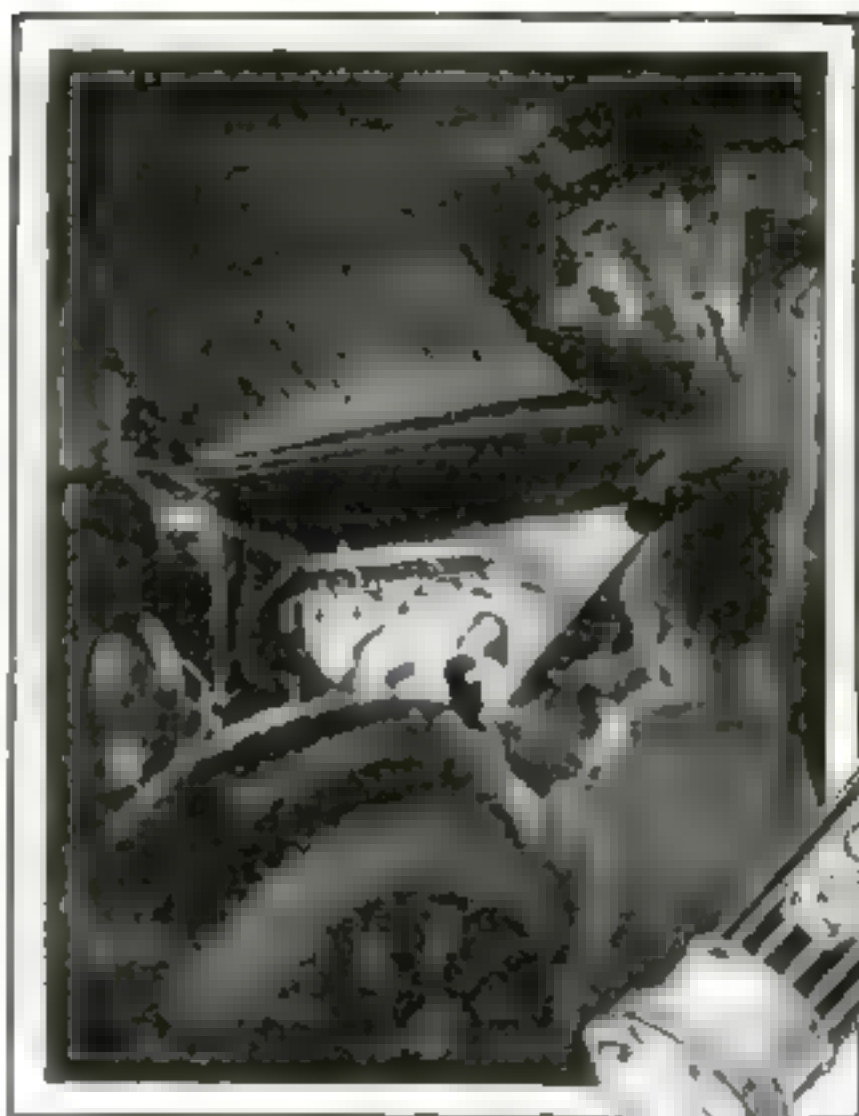
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## Here Are Correct Answers to Questions on Page 29

1. Color is caused by differences in the length of light waves. Our eye sees the longer waves as red; the shorter, as orange, etc. The shortest waves of visible light are violet. White light consists of light of all the colors.
2. The explosion of dynamite is very different from burning; it is a kind of disintegration. All the atoms fly apart from each other very suddenly. Mere burning will not make the atoms fly apart.
3. It is believed that the two billion or so stars that we can see in a telescope all belong to a great group or cloud that has somewhat the shape of a watch. We are near the center. Accordingly, as we look out toward the edge of the watch we look through a greater thickness of the star-cloud and we see more stars than if we could look in the direction of the face or back of the watch.
4. Microscopic plants, composed of a single living cell, grow on the food and form the mold.
5. Some persons, usually those who are not quite normal, possess a second distinct personality corresponding to what, in normal people, is the unconscious mind. These two parts of the mind may have charge of a person's actions alternately, so that he is like *Dr. Jekyll* and *Mr. Hyde* in Stevenson's story.
6. Heat is lost more rapidly through the air of the desert because the air is drier. Dry air lets heat leak away much faster than moist air.
7. The solid matter of bone is not a living substance. But scattered through the bone there are a number of living cells that are bone makers. They are able to produce the mineral material, mainly phosphate of lime, out of which bones are built up. When the ends of a broken bone are brought together again by the surgeon, these bone-making cells collect there and deposit new bone material in the break.
8. The storage battery does not produce any electricity. It merely stores up what you put in it and lets you get it back later when you want to. The dry battery makes electricity out of chemicals that were put into it when it was made. It is not really dry. It contains a watery solution of the necessary chemicals, but this solution is soaked up in charcoal or some other porous substance so that it will not spill or leak out.
9. We believe that it is because they have little or no power of having abstract ideas. Words represent such ideas. For instance, the word "man" means any man, not merely some one man with whom you happen to be acquainted. Animals do not seem to be able to take this mental step from a knowledge of some single thing to the general, abstract idea including both that thing and other things like it.
10. In the nucleus, the little speck of denser and darker protoplasm that is to be seen inside each living cell, there is a very complicated structure that scientists are sometimes able to see under a powerful microscope. This structure contains a number of tiny granules that are passed on by each cell to the cells that are formed from it. They are believed to be the basis of heredity, but the details of how they control this are still unknown.
11. Certain kinds of bacteria grow in hay. They produce heat. The outside layers of hay hold in this heat and the inside of the pile grows very hot. After a while it catches fire.
12. Their feet are built in a special way so that they can rest upon the individual threads of the web without either breaking these threads or getting stuck fast.



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2-cell focusing Spot-  
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**15 minutes**  
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# MAKE YOUR RANGE A GAS STOVE

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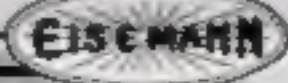
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